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WAR DEPARTMENT.

CORPS OF ENGINEERS, U. S. ARMY.

Survey of Northern and Northwestern Lakes.

BULLETIN No. 12 B.

LAKE MICHIGAN AND GREEN BAY.

TO SUPPLEMENT THE INFORMATION GIVEN UPON THE CHAR. OF THE GREAT LAKES, AND ISSUED WITH THOSE CHARTS FROM THE OFFICE U. S. LAKE SURVEY, DETROIT, MICH.

(ALL PREVIOUS BULLETINS FOR THE ABOVE-NAMED WATERS SHOULD BE DESTROYED.)

NOTE.—This bulletin may also be obtained, upon application, from the following U. S. Engineer Offices: Duluth, Minn., 519 Providence Building; Milwaukee, Wis., Custom-House; Chicago, Ill., 1637 Indiana Avenue; Grand Rapids, Mich., 57 Park Street; Detroit, Mich., Campau Building; Cleveland, Ohio, Hickox Building, 185 Euclid Avenue; Buffalo, N. Y., 540 Federal Building; Oswego, N. Y., Second National Bank Building.

G. L. GILLESPIE,
BRIG. GEN., CHIEF OF ENGINEERS, U. S. ARMY.

1902.

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From the
U. S. Government.

WAR DEPARTMENT

Document No. 157.

OFFICE OF THE CHIEF OF ENGINEERS

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THE GREAT LAKES, THEIR HARBORS, CHANNELS, AND NAVIGABLE TRIBUTARIES.

BULLETIN NO. 12 B, MAY 22, 1902.

The charts to which the information pertains are designated in *italics* for each harbor, channel, or tributary.
Bearings are true, and distances in statute miles.
Depths refer to mean lake level[1] if not otherwise stated.

LAKE MICHIGAN (INCLUDING GREEN BAY).

Length, steamer track, Chicago to Straits of Mackinac	miles	321
Length (right line) from about 87° 30′, south end, to 85° 45′, north end	miles	307
Breadth (right line) on about 45° 25′ north latitude	do	118
Depth, maximum recorded by Lake Survey	feet	870
*Area of water surface	square miles	22,400
*Area drained	do	45,700
*Area, total, of basin	do	68,100
†Rainfall, average annual	inches	33
‡Mean surface above mean tide at New York City (42 years, 1860–1901)	feet	581.05
‡Standard high water (of 1838) above mean tide at New York City	feet	584.34
‡Standard low water (adopted for new charts) above mean tide at New York City	feet	578.00
‡Mean surface below mean surface of Lake Superior	do	20.69
‡Mean surface above mean surface of Lake Huron	do	0.0
*Opening of navigation, average date at Straits of Mackinac		April 17
*Closing of navigation, average date at Straits of Mackinac		January 9

U. S. WEATHER BUREAU STORM-WARNING DISPLAY STATIONS.†

BIG SABLE POINT, MICH. *Flagstaff.*—One mile south of light, 120 feet west of life-saving station.

CALUMET, ILL. *See* Chicago.

CHARLEVOIX, MICH. *Flagstaff.*—In front of telegraph office, near the bridge and opera house.

CHICAGO, ILL. *Flagstaffs.*—Auditorium tower, and at life-saving station on Illinois Central Pier No. 1. SOUTH CHICAGO. *Steel tower.*—On southwest corner of Life-Saving Service reservation. Electric lights.

[1] For period 1860–1875, 581.28 feet above mean tide at New York City.
*Deep Waterways Commission, 1896.
†United States Weather Bureau.
‡Subject to correction; measurements now in progress.

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ESCANABA, MICH. *Steel tower.*—On roof of office building corner Harrison avenue and Ludington street.

FORD RIVER, MICH. *Flagstaff.*

FRANKFORT, MICH. *Steel tower.*—On bluff, south side of harbor.

GLADSTONE, MICH. *Flagstaff.*—Top of elevator at docks of "Soo" Railway.

GLEN HAVEN, MICH. *Flagstaff.*—On outer end of Day's Pier.

GRAND HAVEN, MICH. *Steel tower.*—Cutler House, corner Third and Washington streets. Electric lights.

GREEN BAY, WIS. *Flagstaff.*—Corner of Washington and Main streets.

HOLLAND, MICH. *Flagstaff.*—At life-saving station, Ottawa Beach.

KENOSHA, WIS. *Flagstaff.*—Simmon's Block, northeast corner of Main and Pearl streets. Electric lights.

KEWAUNEE, WIS. *Flagstaff.*—Near harbor, close to telegraph office.

LUDINGTON, MICH. *Steel tower.*—Three blocks from lake. Electric lights.

MACKINAW, MICH. *Steel tower.*—On grounds of the Lake Marine News Association. Electric lights.

MANISTEE, MICH. *Steel tower.*—Corner of Pine and Second streets. Electric lights. *Flagstaff.*—At life-saving station, north side of entrance to harbor.

MANISTIQUE, MICH. *Flagstaff.*—Office of Chicago Lumbering Company, 220 yards north of dock. Electric lights.

MANITOWOC, WIS. *Steel tower.*—On river front, two blocks from lake. Electric lights.

MENOMINEE, MICH. *Flagstaff.*—No. 1 Engine House. Electric lights.

MICHIGAN CITY, IND. *Flagstaff.*—Franklin Street bridge.

MILWAUKEE, WIS. *Flagstaff.*—Mitchell Building, southeast corner East Water and Michigan streets. Electric lights. Life-saving station. *Flagstaff.*—Jones Island, near entrance to Milwaukee River; displays day warnings only.

MUSKEGON, MICH. *Steel tower.*—At Pere Marquette Railroad Depot, near Goodrich Dock. Electric lights.

RACINE, WIS. *Steel tower.*—One block from lake on elevated ground. Electric lights.

ST. JOSEPH, MICH. *Steel tower.*—On bluff near Hotel Whitcomb. Electric lights.

SAUGATUCK, MICH. *Flagstaff.*—Mason street, opposite Saugatuck House.

SHEBOYGAN, WIS. *Steel tower.*—Post Office Block. Electric lights.

SOUTH CHICAGO, ILL. *See* Chicago.

SOUTH HAVEN, MICH. *Steel tower.*—On lighthouse reservation.

STURGEON BAY, WIS. *Flagstaff*—One thousand feet east from draw of bridge. Electric lights.

U. S. LIFE-SAVING STATIONS.*

BAILEYS HARBOR, WIS. On easterly side of harbor.

BEAVER ISLAND, MICH. Near light in harbor.

BIG SABLE POINT, MICH. One mile south of light on Big Sable Point.

CHARLEVOIX, MICH. South side entrance of harbor.

CALUMET, ILL. *See* South Chicago.

CHICAGO, ILL. North end of Jackson Park. OLD CHICAGO. South side entrance to Chicago River on Illinois Central Pier No. 1. *See* also South Chicago.

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*Reports of United States Life-Saving Service.

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EVANSTON, ILL. On the Northwestern University grounds.
FRANKFORT, MICH. South side entrance of harbor.
GRAND HAVEN, MICH. North side entrance of harbor.
GRANDE POINTE AU SABLE, MICH. *See* Big Sable Point.
HOLLAND, MICH. In the harbor, south side.
KENOSHA, WIS. In the harbor, on Washington Island.
KEWAUNEE, WIS. North side entrance of harbor.
LUDINGTON, MICH. North side entrance of harbor.
MANISTEE, MICH. North side entrance of harbor.
MICHIGAN CITY, IND. East side entrance of harbor.
MILWAUKEE, WIS. On Jones Island, south side entrance of harbor.
MUSKEGON, MICH. North side entrance of harbor.
NORTH MANITOU ISLAND, MICH. Near Pickard's Wharf.
PENTWATER, MICH. North side entrance of harbor.
PLUM ISLAND, WIS. Near northeast point of island, 2 miles northwest of Pilot Island light.
POINT BETSIE, MICH. Near light.
RACINE, WIS. In the harbor.
ST. JOSEPH, MICH. In the harbor, north side.
SHEBOYGAN, WIS. Entrance to harbor, north side.
SLEEPING BEAR POINT, MICH. About 1½ miles northwesterly of Glen Haven.
SOUTH CHICAGO, ILL. North side entrance of Calumet Harbor.
SOUTH HAVEN, MICH. North side entrance of harbor.
SOUTH MANITOU ISLAND, MICH. South side of harbor.
STURGEON BAY CANAL, WIS. At easterly entrance, north side.
TWO RIVERS, WIS. North side entrance of harbor.
WHITE RIVER, MICH. North side entrance of White Lake.

EAST SHORE OF LAKE MICHIGAN.

The east shore of Lake Michigan is generally composed of fine sand, large quantities of which are set in motion by severe on-shore winds and storms. Such harbors as existed before improvement by the United States were in the mouths of creeks or small rivers, or the outlets from small lakes near the lake shore, either in their natural condition or partially improved by local enterprise. At many of them sufficient depths for large vessels existed within the shore line and in the main lake just outside, but the entrances were obstructed by extensive bars (generally close to the shore line), formed partly by the sand thrown up by storm waves, or blown from the banks into the streams and carried down by the current, and partly by the sediment brought down from the upper watersheds. During the stormy season, when the harbors were most needed for shelter, the bars increased in height and extent, and although somewhat cut down by scour during the freshet period, they rendered the channels shifting and uncertain at all times.

In 1836 the United States began works of improvement at Michigan City and St. Joseph; in 1866 and 1867 operations were begun at various other harbors on the east shore, the chief object being the removal of the bars at the entrances. The invariable plan was to confine the current between parallel piers, walls, or jetties, suitably directed, and a moderate distance apart, varying with the size of the stream and the needs of the harbor. Before improvement by the Government, depths at natural entrances varied from barely enough to permit the

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passage of small fishing boats up to 11 feet at Muskegon and 12 feet at Grand Haven, at both of which places an increased depth had been secured by works constructed by local interests. In every case the channel was greatly improved by Government operations, the bar being washed into deeper water; but, with the extension of the piers into the lake the shore line advanced, the lake bottom was built up on both sides of the entrance by the sand set in motion by winds and currents, and intercepted by the piers, and the entrance channel again shoaled, but usually not back to the original depth. This shoaling was followed by pier extensions and dredging, effecting the present channel depths, which, although invariably much greater than before improvement, are sometimes insufficient for the larger vessels of to-day. The natural processes which formed the original bars are still in operation, and, as time goes on, the channels deteriorate unless dredging on a large scale is resorted to, or the piers extended. At most of the harbors the piers are now so long that repairs and maintenance make serious inroads upon available funds, and at all of them dredging is usually required each spring. Further extension of piers can, in most instances, afford but temporary relief at disproportionate cost; dredging is the only remedy adequate to maintain existing depths and to prevent further radical advance of the shore lines.

It is of especial importance to navigation interests to note that the dangerous storms of the fall, winter, and early spring are usually westerly, making entrance to the restricted harbor channels of the east shore especially difficult, and sometimes increasing dangers by the formation of storm bars.

When existing projects are completed, there will be upon this shore three artificial harbors of refuge, affording a depth of not less than 18 feet, including Portage Lake, with an entrance 370 feet wide, 9 miles north of Manistee, and not more than 12 miles due east of the direct course from South Manitou to Chicago; Grand Haven, with an entrance 400 feet wide, and Michigan City, with one 650 feet wide. Harbor Springs, on the north shore of Little Traverse Bay, while limited in area, is one of the finest natural harbors of refuge on the lakes, affording security in any weather. Petoskey Harbor, on the south shore of Little Traverse Bay, is formed by two detached breakwaters with an entrance between them 150 feet in width; these breakwaters, however, were built to shelter the wharf, and it is a difficult harbor for smaller craft to enter in stormy weather, and for larger vessels to make at any time.

WEST SHORE OF LAKE MICHIGAN.

Most of the rivers flowing into Lake Michigan from the west are small and unimportant, the only large streams being the Menominee and the Fox, both of which empty into Green Bay, the most important arm of Lake Michigan. The harbors along the western shore of Lake Michigan are generally located at the mouths of rivers, the improvement consisting of two parallel piers extending into the lake, and protecting a dredged channel. Two harbors, Waukegan, Ill., and Port Washington, Wis., are entirely artificial, consisting of dredged basins protected by piers and revetments. The only natural harbors, never improved by the United States, are Escanaba and Gladstone, Mich., situated on Little Bay de Noquette. One harbor of refuge, located in Milwaukee Bay and protected by a breakwater, affords commodious and safe anchorage for all classes of vessels. Green Bay and Lake Michigan are connected by a canal extending from Lake Michigan to the head of Sturgeon Bay, an estuary of Green Bay.

As a result of the improvements made and maintained by the United States, all of the important harbors on the west shore of the lake are now accessible to

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vessels drawing from 18 to 20 feet. Before these improvements were made the maximum draft did not exceed 10 or 12 feet, and as the mouths of the rivers were generally obstructed by bars, landings were made at projecting "bridge" piers, which could be used only in comparatively calm weather.

The rivers being generally small and draining comparatively limited areas, carry down slight quantities of material, and freshets therefore cause little silting up of the channels. While dredging for the maintenance of all the artificial channels is necessary, usually on account of sand washed in from the lake, there is marked difference in the quantity of dredging required between harbors situated only a few miles apart.

The harbor at Manitowoc, Wis., is about 6 miles southwest of Two Rivers, and about 25 miles north of Sheboygan. At Manitowoc dredging is necessary only once in three or four years, while it is required annually at Two Rivers and Sheboygan. Similarly, Milwaukee is about 21 miles to the north of Racine; at the latter place it is necessary to dredge annually, while at Milwaukee once in three or four years is sufficient.

Both Manitowoc and Milwaukee are situated at the mouths of rivers rather larger than the average for the west shore; but both harbors are located in bays, which afford protection from storms. It is the littoral drift of sand due to storms and currents, rather than material brought down by the rivers, that tends to obstruct the channel entrances. This drift extends into bays only in a small measure, but along the general shore it is more or less continuous, being greatest during storms. South of Manitowoc the drift is generally to the southward; north of Manitowoc, while not so well defined, it is generally to the northward.

The winter navigation of Lake Michigan is of importance, and is increasing. At the present time there are the following regular winter lines of steamers in this district:

Two lines from Milwaukee to Racine and Chicago.
One line from Milwaukee to Sturgeon Bay Canal and intermediate ports.
One line from Milwaukee to Grand Haven.
One line from Milwaukee to Ludington.
One line from Manitowoc to Ludington.
One line from Manitowoc and Kewaunee to Frankfort.

Efforts have been made to maintain a regular winter line from Frankfort to Menominee, via Sturgeon Bay Canal or "Death's Door," but as yet they have not proved successful.

ALGOMA, WIS. (FORMERLY AHNAPEE). The entrance to this harbor is formed by two piers extending into Lake Michigan at the mouth of Ahnapee or Wolf River. In the immediate vicinity of the piers the elevation of the ground is only a few feet above lake level, but at about 500 feet north and 2,500 feet south, it rises to a height of 40 feet or more.

Original condition: A depth of 2 feet of water at entrance; 500 feet inside thereof, a limestone ledge with a depth of 4 feet over it.

The present project provides for the maintenance of existing works and the completion of the 13-foot channel 100 feet wide to the bridge (a distance of about 1,000 feet inside of the present shore line), and 50 feet wide for a distance of 800 feet above the bridge.

Dredging is frequently necessary to maintain the required depth between the piers.

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The north pier consists of a main structure 802 feet long and a detached portion 300 feet long; the south pier, of a main structure 975 feet long and a detached portion 150 feet long. The main and detached piers are connected by guide piling and project beyond the present shore line 1,050 feet and 710 feet, respectively. The clear width between them at entrance is 200 feet, and at the narrowest part 125 feet.

The length of the improved channel from the harbor entrance to the upper end thereof is about 2,500 feet.

July 18, 1901, there was a depth at the entrance of 16.1 feet; thence to the shore end of the harbor piers, a channel with a least width of 90 feet and a least depth of 11.8 feet; thence to the bridge, a channel about 11 feet deep, with a least width of about 60 feet; thence for a distance of 520 feet above the bridge the channel is 30 feet wide with a depth of 10 feet. These soundings are reduced to the stage of water represented on the charts. The actual stage on the date specified was 0.8 foot lower.

The channel, though narrow, is easily and safely navigated.

Bridge.

Locality.	Kind.	Height.*	Draw opening in the clear.		Remarks.
			Right.†	Left.†	
		Feet.	*Feet.*	*Feet.*	
Across the Ahnapee or Wolf River at Second street, about 2,000 feet from harbor entrance.	Highway	7	73	73	Not lighted for navigation purposes; seldom opened; left draw not accessible.

* Lowest part of superstructure above low water represented on the charts.
† Looking downstream toward the lake.

Harbor Rules and Regulations.

SEC. 2. It shall be the duty of the harbor master * * * to prevent any and all persons from putting any sawdust, logs, bark, or any other material or thing into said river or harbor, and from making or erecting any nuisance therein; to have charge of any and all vessels lying in said river or harbor, to determine where they shall lie, and also to remove any and all vessels to some other place when the public or private good, in his opinion, will be better subserved, and to settle any and all claims of any and all vessels as to their right or priority of place in said river or harbor, and to make all needful rules for the government of the river and harbor, subject to the approval of the city council.

SEC. 3. The said harbor master shall have police powers, and as such may exercise the duties of a constable or other police officer in keeping the peace in, on, or about the harbor or river in said city, and for that purpose he may arrest with or without process any and all persons there found violating any law of this State or ordinance of this city, and bring them before the police justice of said city to be dealt with according to law and the ordinances of said city.

SEC. 4. Any person or persons who shall be guilty of placing any logs, sawdust, bark, or other material or thing in said harbor or river, or shall make, erect, or place any obstruction or nuisance in said river or harbor shall be guilty of a misdemeanor, and on conviction thereof, shall be fined not more than ten dollars nor less than one dollar for each and every offense.

SEC. 5. Any person or persons who shall refuse to obey any reasonable rule or order of said harbor master, shall on conviction thereof, forfeit to said city the sum of not less than five and not more than twenty-five dollars.

Ahnapee or Wolf River is navigable as far as the first rapids, about 7 miles distant from the mouth, with a depth of water of not less than 6 feet. The bed of the river is solid rock.

Charts: Coast Chart No. 1, Lake Michigan; North End of Lake Michigan; Lake Michigan.

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ARCADIA, MICH. Is situated on North Bar Lake, a body of water 4,800 feet long, north and south, with an extreme width of about 3,400 feet in the southern part. From the north end, about 3,000 feet of the length of the lake is from 300 to 800 feet wide and 20 to 38 feet deep, with the 18-foot curve following very close to the shore line. This part of the lake is parallel to the shore line of Lake Michigan and separated from it by a narrow strip of land from 300 to 750 feet wide. Arcadia is situated at the north end of this deep, narrow portion of the lake. The larger, southern portion has depths of 15 feet or more in its western half, and shoals off into a marsh at the east end, where it receives its only stream (Bar Creek). The channel connecting with Lake Michigan is about 3,700 feet from the north end and 1,100 feet from the south end of North Bar Lake. The sides were protected by slab and pile revetments and two piers were built into Lake Michigan. *June 7, 1899.*—The north pier was 1,085 feet long and projected 660 feet beyond the shore line; the south pier was 1,341 feet long and projected 550 feet beyond the shore line; the available depth between the piers was from 11.5 to 12 feet; the width between the piers was 165 feet at the inner end and wider at the outer end.

Charts: Coast Chart No. 9, Lake Michigan; North End of Lake Michigan; Lake Michigan.

AUX BECS SCIES LAKE, MICH. *See* Frankfort.

BEAVER ISLAND, MICH. Beaver Harbor, near the northeast point of Beaver Island, affords shelter from all except southeast winds.

Charts: North End of Lake Michigan; Beaver Island Group; Lake Michigan.

BENONA, MICH. (ON EAST SHORE OF LAKE MICHIGAN, AT THE FOOT OF STONY LAKE, ABOUT 13½ MILES NORTH OF WHITE LAKE HARBOR). Stony Lake is about 8,100 feet long and from 900 to 1,800 feet wide, with depths of from 15 to 51 feet, the 15-foot curve being within about 100 feet of the shore line, except at the extreme east end, where the lake becomes shoaler. Stony Creek, a shallow stream about 30 or 40 feet wide, enters the lake at the extreme northeast corner and leaves at the northwest corner of the lake. The distance in a straight line from Stony Lake to Lake Michigan is about 3,300 feet; by the creek channel the distance is about ⅞ mile. A survey made in 1895 is said to have shown a fall of 2 feet from Stony Lake to Lake Michigan. A bridge pier with a tramway extended into Lake Michigan at the mouth of Stony Creek. About 300 or 400 feet of the pier remain in a ruinous condition.

Charts: Coast Chart No. 8, Lake Michigan; South End of Lake Michigan; Lake Michigan.

BENTON HARBOR, MICH. *See* St. Joseph.

BETSIE, LAKE, MICH. *See* Frankfort.

BLACK LAKE, MICH. *See* Holland.

BLACK RIVER, MICH. *See* South Haven.

BOWERS HARBOR, MICH. A bay on the west side of the peninsula projecting into Grand Traverse Bay. It affords safe shelter from all except southwesterly winds.

Charts: Grand and Little Traverse Bays; North End of Lake Michigan; Lake Michigan.

CALUMET OR SOUTH CHICAGO HARBOR, ILL. Originally this harbor could be used by none but the smallest craft, and then only when temporarily deepened by scour due to freshets. Before improvement by the Government, Calumet River made a sharp turn to the southward upon approaching the lake shore, to

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which it ran parallel for a considerable distance before emptying into the lake, being separated from the latter by a long narrow sand spit. The formation and extension southward of the spit were probably due to the action of the river current and of the waves raised in the lake by the prevailing northerly winds, lake and river depositing the sand and silt which both carried in suspension, at the point where the opposing currents met. Over the bar at the mouth there was at times a fluctuating channel, 2 to 3 feet in depth, and an available channel 7 feet in depth in the river inside of the bar.

The first improvement was undertaken by the Government in 1870 and consisted in cutting through the sand spit at the point where the river made the sharp turn to the southward, in protecting the banks of this cut by pile pier revetments, and in aiding the natural scouring action in the channel between the piers, by dredging to a depth of 13½ feet; in later years this depth was gradually increased to 16, 21.8, and, for this year's dredging, to 22.8 feet.

The present project for improvement includes:

1. A breakwater or breakwaters, affording an outer harbor of refuge and such shelter that vessels may safely enter the inner harbor at all times.

2. An extension of one or both of the piers.

3. A deepening of the harbor entrance to 21.8 feet, and of the river channel to the same depth, for a width of 200 feet, and for a distance of about 2 miles upstream.

The works of improvement thus far constructed include the two piers at the mouth of the Calumet River, and an outer breakwater. The piers are 300 feet apart; the south pier projects about 2,165 feet and the north pier about 1,140 feet beyond the shore line. The outer breakwater is under construction; it is now 4,100 feet in length with the superstructure completed over the westerly 3,400 feet. Its projected length is 4,400 feet extending due east from the outer end of the Illinois Steel Company's north pier. *December 5, 1901.*—The field notes of the recent survey of the harbor indicate a bar in a direct line with the channel between the harbor piers, and at a distance of 8,250 feet from the outer end of the north pier. It is about 200 feet in diameter and the shallowest sounding found thereon was 20.6 feet. As vessels are forced farther out toward this bar by the extension of the new breakwater, it is, in stormy weather, a serious obstruction, and a red and black striped spar buoy has been placed about 300 feet to the northward, in 21 feet of water. Shoaling has taken place along both sides of the channel, and a bar has formed on the northerly side of the harbor entrance, extending about one-half of the distance across the channel, with depths ranging from 17.7 feet on the line of the axis of the north pier to 20.3 feet nearly in mid-channel. (*June 4, 1902.*—This bar is now nearly removed.) The entrance channel has an available depth of about 20.8 feet at low water, on a line about 100 feet north of the prolongation of the south pier and parallel to it, until opposite the lighthouse at the outer end of the north pier, thence in line of the center of the channel.

The Illinois Steel Company's private harbor (3,000 feet north of Calumet Harbor) is practicable at low water for vessels drawing 18.5 feet. It is the aim of the company to maintain a depth of 20 feet in the slips and river and 21 feet in the exposed channel. Their north slip is 200 feet wide, contracted at the mouth to 100 feet in width, to prevent internal disturbance.

Charts: Lake Front, Chicago, Ill., including Calumet Harbor; Coast Chart No. 5, Lake Michigan; South End of Lake Michigan; Lake Michigan.

CALUMET RIVER, ILL. AND IND. This river empties into Lake Michigan at South Chicago, and its mouth is known as Calumet Harbor. About 6½ miles up the river there is a connection with Lake Calumet through a narrow channel

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about 2,000 feet in length, described in 1882 as varying from 4 to 6 feet in depth. Lake Calumet is about 3¼ miles in length north and south, about 1¼ miles wide, averages about 5 feet in depth at low water, and is at practically the same elevation as Lake Michigan. About 1¼ miles above the connection with Lake Calumet, or about 8¼ miles from Lake Michigan, the Little Calumet joins the Calumet. The city of Hammond is situated on the Calumet about 11 miles above its mouth. Above the junction with the Little Calumet, the Calumet, or Grand Calumet, is a lagoon or bayou with little current and with banks just above the water surface. Its drainage area is slight. The Little Calumet drains a much larger area, with a considerable flood discharge, but its low-water flow is small. The depth of the Little Calumet up to the mouth of Stony Creek, about 6¼ miles, averages about 8 feet and the width a little less than 200 feet.

The project for improvement contemplates a channel 200 feet in width and 21.8 feet deep for 2 miles above the mouth of the Calumet, and 17.8 feet deep to ¼ mile east of Hammond.

September 1, 1900.—The channel from One hundred and sixth street to One hundred and eighteenth street has just been redredged and has now a depth of 17.8 feet or more, for a width of 200 feet (except a section between One hundred and twelfth and One hundred and thirteenth streets, where that depth is only found for a width of about 80 feet at the westerly side, the rock bottom at the opposite side preventing dredging). *January, 1902.*—The recent survey indicates a 20.8-foot channel—generally along the center of the river—from the harbor to about the ship yard; thence about 19.8 feet to One hundred and sixth Street bridge. Seventeen and eight-tenths feet can be carried to One hundred and eighteenth street; thence to Hammond, Ind., not exceeding 5 feet at low water. A turning basin, 19.8 to 20.8 feet deep, about 250 by 350 feet has been constructed opposite Counselman's elevator slip. At Ninety-fifth street, a center-channel bridge is now being substituted for the old center-pier bridge. The channel draws of the three railroad bridges near Ninety-seventh street have now a uniform width of 85 feet.

The rules and regulations relative to navigation are the same for the Calumet River as for the Chicago River, and are given in connection with the data for the latter river.

The bridges across the part of Calumet River below the "Forks," which is the section along which channel lines have been officially established, are as follows:

Calumet River Bridges, between the harbor and the "Forks."

No.	Name of bridge.	Kind.	Draw opening in the clear.			Remarks.
			Right.*	Center.	Left.*	
			Feet.	*Feet.*	*Feet.*	
1	Chicago and Eastern	Railway	98		96	
2	Ninety-second street	Highway	72		70	
3	Ninety-fifth street	do		120		Now under construction.
4	Baltimore and Ohio	Railway	85			Bobtail.
5	L. S. & M. S.	do			85	Do.
6	P., Ft. W. & C.	do	85			Do.
7	One hundred and sixth street	Highway	64		56	
8	Chittenden	do		50		Old ponton.
9	Calumet Western	Railway	60		35	Now under construction.
10	Western Indiana	do	37		38	
11	N. Y., C. & St. L.	do			53	Left draw not accessible.

* Looking downstream toward the lake.

Charts: Lake Front, Chicago, including Calumet Harbor; Coast Chart No. 5, Lake Michigan; South End of Lake Michigan, Lake Michigan.

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CAT HEAD POINT AND BAY, MICH. At north end of Leelanaw Peninsula. Afford shelter in southerly winds.

Charts: Grand and Little Traverse Bays; North End of Lake Michigan; Lake Michigan.

CEDAR RIVER, MICH. Original depth from 8 to 10 feet, obstructed by an outer bar with a depth of only about 3 feet. The work of improvement was commenced by the United States in 1883 under a project contemplating the construction of two piers, 200 feet apart, extending from the river mouth to the 16-foot curve in Green Bay, and the dredging of a channel not less than 12 feet deep at low water; work was suspended in 1885, and has not since been resumed by the United States.

The east pier is 754 feet long, and the west pier 301 feet long; they project beyond the shore line 754 feet and 275 feet, respectively. The distance between the piers is 210.3 feet opposite the lake end of the west pier, and 205.6 feet opposite the shore end of the east pier.

About 2,000 feet from the shore end of the harbor piers a bridge spans the river; clear width of draws 25 feet each; clear height of superstructure above the water surface 8 feet. Not lighted for navigation purposes, being above the head of general navigation.

April 20, 1894.—There was a narrow channel with a depth of about 14.5 feet at the stage of water represented on the charts. The actual stage on the date specified was 1.2 feet lower.

Charts: North End of Green Bay; South End of Green Bay; North End of Lake Michigan; Lake Michigan.

CENTERVILLE, WIS. (HIKA POST OFFICE. WEST SHORE OF LAKE MICHIGAN, 11 MILES NORTH OF SHEBOYGAN.) There being no natural harbor, "bridge piers," consisting of piles sawed off some 8 or 10 feet above the water surface and decked over, were built out to 12 feet depth. In 1888 the south pier only was kept up. Centerville Creek is very small and shallow, not over 3 or 4 feet deep, and 10 or 12 feet wide, with perhaps 18 inches on the bar at the mouth.

Charts: Coast Chart No. 2, Lake Michigan; South End of Lake Michigan; Lake Michigan.

CHARLEVOIX, MICH. At the mouth of Pine River, on the eastern shore of Lake Michigan, about 35 miles from the western entrance of the Straits of Mackinac, and upon the neck of land between Grand and Little Traverse Bays. The Pine River affords access through its lower portion (Lower Channel) to Round Lake, which is really the harbor proper of Charlevoix, and thence through the Upper Channel to Pine Lake. Round Lake is about ¼ mile in diameter and affords maximum depths of over 40 feet. Pine Lake is about 15 miles long and 1 to 2 miles wide, and is navigable to its upper end for boats drawing about 12 feet; in the lower portion there are depths in excess of 60 feet.

In 1866 the available channel in Pine River between Lake Michigan and Round Lake was 75 feet wide and 2 to 6 feet deep. The then existing obstructions were stable in character and largely composed of gravel bars. The maximum draft which can be carried through to Pine Lake is now 14.1 feet.

The present project provides for a 12-foot channel from Lake Michigan to Round Lake between piers and revetments 100 to 150 feet apart, and from Round to Pine Lake between revetments 83 feet apart. The entrance from Lake Michigan is protected by two piers and revetments. The north pier and revetment are 1,725 feet and the south pier and revetment 2,030 feet long; the north pier projects 755 feet and the south pier 365 feet beyond the shore line. The clear

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width between piers at the entrance is 160 feet and at the narrowest part of the passage between them about 100 feet. From the outer ends of the piers the entrance channel bears about S. 61° E. for 650 feet, thence about S. 71° 30′ E. for 850 feet, thence S. 85° E. 500 feet, thence approximately S. 66° E. through Round Lake, thence about S. 71° 30′ E. through the Upper Channel and into Pine Lake.

The Lower Channel from Lake Michigan to Round Lake is 2,000 feet long, affording, in July, 1901, for a width of 60 feet, a depth of 16 feet. The channel is easily navigated. At its upper end it is crossed by a highway bridge, subsequently described. The channel from Round Lake to Pine Lake is 1,500 feet long with a depth in the center of 14.1 feet. The revetment on the north side is 339 feet long, and that on the south side is 366 feet long. Both revetments are in bad condition. The clear width between the revetments is 83 feet. The channel in Pine Lake extends to Boyne City with a least depth near Boyne City of 12 feet. About 6 miles from its west end, an arm of Pine Lake extends southward 8 miles to the villages of East Jordan and South Arm, to which 12 feet can be carried.

The Lower Channel near its upper end is crossed by a highway drawbridge with unequal spans, with a clear width in the south or left opening of 74 feet, the north or right opening being inaccessible. There is a compound red and white light on this bridge 47 feet above the water over the center of the channel when the bridge is closed, and showing red on the channel when the bridge is closed. There is also a cluster of four white lights on the center of bridge and center line of guard pier 36 feet above the water.

The Upper Channel is crossed at its upper end by the drawbridge of the Pere Marquette Railroad Company with a width of 90 feet on the south or left opening; the other opening is not accessible. This bridge is provided with three compound red and green lights, one at each end and one at center of bridge, 52 feet above the water; three red lights on the guard pier, and two red lights on the south abutment. This bridge is always kept open except for the passage of trains.

No harbor regulations exist at this harbor.

Charts: Grand and Little Traverse Bays; North End of Lake Michigan; Lake Michigan.

CHICAGO HARBOR, ILL. Originally this harbor could be used by none but the smallest craft, and then only when temporarily deepened by scour due to freshets. Before improvement by the Government, Chicago River made a sharp turn to the southward upon approaching the lake shore, to which it ran parallel for a considerable distance before emptying into the lake, being separated from the latter by a long narrow sand spit, which is said to have extended nearly down to Twelfth street. The formation and extension of this spit were probably due to the action of the river current and of the waves raised in the lake by the prevailing northerly winds, lake and river depositing the sand and silt, which both carried in suspension, at the point where the opposing currents met. The depth over the bar was 3 to 4 feet. The first improvement was undertaken by the Government in 1833 and consisted in cutting through the sand spit at the point where the river made the sharp turn to the southward, in protecting the banks of this cut by pile pier revetments, and in aiding the natural scouring of the channel between the piers by dredging. In 1870, to provide a safe anchorage ground for vessels loaded for departure but detained by gales, or for others seeking shelter at such times; also to provide facilities for relieving the overcrowded condition of the river, and to protect the wharves and slips proposed

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to be constructed along the lake front between Randolph and Twelfth streets, the easterly breakwater was projected, and later the southerly breakwater. In 1878, to facilitate entrance to the harbor, and to provide a sheltered anchorage ground in deep water during severe northerly storms, the exterior breakwater was proposed.

The works of improvement constructed include the dredged basin and channels, the piers at the mouth of the Chicago River, and the easterly, southerly, and exterior breakwaters.

The exterior breakwater is about ¾ mile northeast of the entrance to the river; it is 5,413 feet long, 30 feet wide, and was constructed between 1880 and 1889 in water varying from 18 to 32 feet in depth. It has proved a decided benefit to navigation. The harbor of refuge between this breakwater and the entrance to the river has a depth of 18 to 32 feet.

The easterly breakwater is about 4,037 feet long, with a shore return at the north end about 300 feet long. The southerly breakwater begins about 750 feet south of the southerly end of the easterly breakwater and is about 3,000 feet long. The easterly and southerly breakwaters, with the south pier to the north and the shore to the west, form the so-called "outer basin." The construction of the proposed wharves and slips along the lake shore from Randolph street to Twelfth street having been delayed from year to year by the lake-front litigation, was finally abandoned, and a bulkhead was built in 1896 along the dock line established by the Secretary of War in August, 1871, and September, 1890; the area west of the bulkhead has been designated as a public park and is being gradually filled in, thereby reducing the area of the basin to 270 acres. Its length is about 7,300 feet, and its greatest width is about 2,000 feet. The distance between the piers at the mouth of Chicago River is about 470 feet, narrowing to about 320 feet just after passing the north entrance to the basin and to about 200 feet just after passing the bridge of the Illinois Central Railroad. The draw openings of that bridge are each 78.7 feet wide in the clear.

The present project for the expenditure of available funds includes dredging the outer bar and entrance to the river as far as to Rush street to a depth of 21.8 feet, dredging northerly end of the basin to a depth of 21.8 feet, refilling superstructure of cribs of basin with stone, and replacing decayed pile fenders at harbor entrance.

August 5, 1901.—The channel over the bar at the entrance, and the channel in the river, up to the east side of Rush Street bridge, have been redredged to a depth of from 21.8 to 22.8 feet, and to within 25 feet of existing docks.

June 4, 1902.—Dredging in the basin was resumed in April, 1902, and the northerly portion, for a width of about 1,150 feet along the easterly breakwater, has been dredged to a depth of 22.8 feet for a distance of 1,700 feet southward from the south pier. It is expected to carry on this work under existing contract, for a distance of about 300 feet farther, or about 2,000 feet from the south pier. The undredged portion of this basin is very irregular in depth, varying from 12 to 20 feet at low water.

The superstructure of the inner or 2.05-mile crib off Twelfth street has been removed to a depth of 25.8 feet. The location is 2.05 miles from the shore east of Twelfth street, and is 1¼ miles from the 4-mile crib, which has a lighthouse. A new inlet crib and a temporary crib have been constructed, the former 14,100 feet and the latter 12,700 feet in an easterly direction from the foot of North avenue. The latter was removed to a depth of 26.8 feet in August, 1900. The Lake View intermediate crib was removed to a depth of 19.8 feet in June, 1900.

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RULES AND REGULATIONS relating to the anchorage and movement of vessels in the Port of Chicago, prescribed by the Secretary of the Treasury, July 9, 1896, and amended May 27, 1902:

Vessels shall anchor within the following specified limits:

1. United States Exterior Breakwater Anchorage, within lines running from Chicago Pierhead Light on North Pier, Chicago River, to the easterly and westerly ends of Exterior Breakwater, and a line parallel to said Breakwater, 2,000 feet southwesterly from the same.

2. *Anchorage grounds in the interior breakwater or basin.*—Vessels shall anchor west of a line drawn south from the east side of the light-house slip and south of a line drawn east from the United States dock line of the east limit of the proposed park at a distance of 300 feet south of the Randolph street pier, and north of a line drawn east from Van Buren street, and south of a line drawn west from the north end of the southerly breakwater (east entrance of Van Buren street gap) and not within 100 feet of the southerly breakwater.

3. Yachts and small excursion vessels may place buoys and lie at anchor within a line drawn south from the end of the Government pier projecting eastward adjacent to the life-saving station at the north entrance of the Chicago interior breakwater or basin, and south of a line drawn east of the United States dock line east limit of proposed park, at a distance of 300 feet south of Randolph street pier, and north of a line drawn east from Van Buren street, and not within 50 feet of the east limit of proposed park.

4. No anchoring or placing of buoys will be permitted in said breakwater or basin outside of the limits defined in Rule 3.

5. Steamers and steamers with tows are prohibited from using as a channel way the grounds set apart in Rule 3 for the anchorage of yachts and small excursion vessels.

GENERAL REGULATIONS.

No vessel shall anchor within 100 feet of any United States Pier or Breakwater.

Nothing in these regulations shall be held to prevent any vessel in stress of weather, or in great emergency, from anchoring anywhere that may seem necessary for safety at the time, but the revenue-cutter officer charged with the enforcement of these regulations shall be the judge as to when such emergency shall have terminated.

The commanding officer of the Revenue Cutter at the port of Chicago is charged with the enforcement of these Rules and Regulations, and is empowered—

(1) To remove from her anchorage any vessel not anchored within the limits hereby prescribed.

(2) To require, when he may deem it advisable, vessels to moor head and stern.

(3) To assign vessels to such part of the Anchorage Grounds as is suitable to their draft.

(4) To assume such general direction of the movement of vessels in the inshore channels as shall least obstruct navigation of the same.

(5) To see that the acts of Congress prohibiting dumping of solids into navigable waters of the United States are complied with and enforced.

Charts: Lake Front, Chicago, including Calumet Harbor; Coast Chart No. 4, Lake Michigan; South End of Lake Michigan; Lake Michigan.

CHICAGO RIVER ENTRANCE. The original condition of this entrance is described in connection with the data relating to Chicago Harbor. The United States Government commenced the work of improvement in 1833 by making a cut through the sand spit at the mouth, thus giving the river a straight outlet; piers were constructed on the north and south banks of this cut and extended from time to time. The distance between the piers at the lake end is about 470 feet, narrowing to about 320 feet just after passing the north entrance to the basin, and to about 200 feet just after passing the bridge of the Illinois Central Railroad. The draw openings of that bridge are each 78.7 feet in the clear.

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August 5, 1901.—The channel over the bar at the entrance and in the river to the east side of Rush Street bridge has been redredged to a depth of from 21.8 to 22.8 feet, to within 25 feet of existing docks.

Charts: Lake Front, Chicago, Ill., including Calumet Harbor; Coast Chart No. 4, Lake Michigan; South End of Lake Michigan; Lake Michigan.

CHICAGO RIVER, ILL. This river constitutes the inner harbor of Chicago. The navigable portions are wholly within the limits of Cook County and of the city of Chicago. Originally it was a sluggish bayou or creek nearly stagnant for the greater part of the year, but had a rapid current in rainy seasons, when discharging the water from its own watershed as well as a large quantity which passed from Des Plaines River over the low divide between the two streams. Chicago River is bifurcated, the North Branch joining the South Branch about 1.3 miles above the mouth. The total length of the main river and branches is about 16 miles. The parts of the river improved by the United States have lengths as follows:

	Miles.
Main river from Ogden's slip to Lake Street bridge	1.36
South Branch, Lake street to Ashland avenue	4.03
South Fork of South Branch to Indiana State Line Railroad bridge	1.60
North Branch to Belmont avenue	5.22
North Branch Canal (Goose Island cut-off)	1.02
Total	13.21

There are along the main channels of these improved stretches 22 miles of docks and wharves, and 6.93 miles in slips. The river is spanned by 54 bridges and there are three tunnels under it—at La Salle, Washington, and Van Buren streets, respectively—having navigable depths of from 16 to 18 feet of water over their crowns at deepest points.

The present project contemplates dredging and minor changes of docks and dock lines to admit passage by vessels drawing 16 feet of water.

The work of the Sanitary District of Chicago in the Chicago River is, first, dredging from the lake to Robey street to a uniform depth (except over tunnels) of 26 feet below the flow line and widening the stream to 200 feet between dock lines; second, constructing between Monroe and Van Buren streets, a covered conduit or by-pass through the lands of the Pennsylvania and Chicago and Alton Railroad companies, with a section for a flow of water of 50 feet in width and 16 feet in depth; third, the removal of obstructive center-pier bridges and the building in their places of bascule bridges, of either the rolling lift or the trunnion type. The foundations of these bridges are placed at a depth which provides for an eventual navigable depth in the river of 30 feet. The redocking of the river is being carried on as fast as the properties can be acquired by purchase or condemnation. The distance via the river from the lake to Robey street is about 6 miles. On December 5, 1901, the Secretary of War granted permission to the Sanitary District of Chicago to so regulate the discharge of water into the Chicago Drainage Canal that the maximum flow through the Chicago River shall not exceed 250,000 cubic feet per minute throughout the twenty-four hours of the day.

January, 1901.—The main river and its branches have been dredged to 18.8 feet and carry that depth from Rush Street bridge to the stock yards in the South Branch and to Belmont avenue in the North Branch (the respective heads of navigation) except where shoaling has taken place.

July, 1901.—The Sanitary District of Chicago has dredged the greater portion of the South Branch between Lake street and the West Fork, to depths varying between 21.8 and 27.8 feet. The most obstructive bends in the river have all, as far as authorized in 1899, been removed. The river deteriorates from sewage as well as from slush in connecting slips.

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Bridges across Chicago River and its branches on March 1, 1902.

Name of bridge.	Kind.	Draw opening in the clear.			Motive power.	Remarks.
		Left.*	Center.	Right.*		
MAIN BRANCH.						
Ill. C. Rwy. Co	Railway	78.7		78.7	Hand	Kept open for vessels.
Rush street	Highway	75.0		76.0	Electy	
State street	do		140.0		do	A bascule bridge with 140 feet center opening is now under construction.
Dearborn street	do	68.5		67.0	do	
Clark street	do	69.0		70.0	do	
Wells street	do	71.5		71.5	do	Double decker. Also used by the N. W. Elevated Railway.
SOUTH BRANCH.						
Lake street	Highway	69.5		65.0	Electy	Double decker. Also used by Lake St. Elevated Railway.
Randolph street	do		140.0		do	Bascule bridge now under construction.
Washington street	do	50.0		53.0	do	
Madison street	do	55.0		55.0	Steam	
Adams street	do			82.0	Electy	Left draw not available.
Jackson street	do			87.0	do	Do.
Metropolitan Elevated	El. Rwy		93.0		do	Bascule type.
Van Buren street	Highway		83.2		do	Do.
Harrison street	do		140.0		do	Bascule bridge under construction. Old bridge removed.
Polk street	do	52.0		50.0	Hand	
Taylor street	do		120.0		Electy	Bascule type.
Chicago T. T. Rwy. Co	Railway		120.0		do	Bascule type now in operation. Old bridge is being removed.
Twelfth street	Highway	58.0		62.0	Steam	
C., B. & Q. Rwy Co	Railway	70.0		60.0	do	
Eighteenth street	Highway	40.0		55.0	do	
C., P. & Ft. W. Rwy	Railway	55.0		52.0	do	
Canal street	Highway		140.0		Electy	Bascule under construction.
Twenty-second street	do	50.0		50.0	Hand	
South Halsted street	do		95.0		Steam	Lift bridge.
Main (Throop) street	do		140.0		Electy	Bascule under construction.
Deering street	do	65.0		39.0	Hand	
WEST FORK OF THE SOUTH BRANCH.						
Ashland avenue	Highway		140.0		Electy	Bascule under construction.
Southwest boulevard	do	47.1		46.7	Hand	Head of navigation.
SOUTH FORK OF THE SOUTH BRANCH.						
Fuller street	Highway	45.0			Hand	Right draw not accessible.
Chicago and Alton Rwy	Railway	53.0			Steam	Do.
Archer avenue	Highway	34.0		58.0	Hand	
Thirty-fifth street	do	60.0		55.0	do	
WEST ARM OF THE SOUTH FORK OF THE SOUTH BRANCH.						
Chic. & Ind. State Line R. R.	Rwy. and Hwy.	46.0		36.0	Hand	Right draw inaccessible; E. ½ Railway; W. ½ Highway.
Ashland avenue	Highway	56.0		54.0	do	
EAST ARM OF THE SOUTH FORK OF THE SOUTH BRANCH.						
C. & I. St. Line Rwy	Railway	45.0		40.0	Hand	
Laurel street	Highway			55.5	do	Left draw inaccessible; head of navigation.
NORTH BRANCH.						
C. & N. W. Rwy	Railway			58.0	Electy	Left draw inaccessible.
Kinzie street	Highway			49.8	Hand	Do.
C., M. & St. P. Rwy	Railway			60.2	Steam	Do.
Indiana street	Highway	42.8		47.5	Hand	

*Right and left refer to sides when looking toward the lake.

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Bridges across Chicago River and its branches on March 1, 1902—Continued.

Name of bridge.	Kind.	Draw opening in the clear.			Motive power.	Remarks.
		Left.*	Center.	Right.*		
Erie street	Highway	30.0		66.4	Hand	
Chicago avenue	do	52.9		53.1	do	
N. Halsted street	do		102.3		Electy	Bascule bridge.
Division street	do	46.7		42.3	Hand	Right draw inaccessible.
North avenue	do	49.1		48.9	do	
C., M. & St. P. Rwy	Railway			87.0	Electy	Left draw inaccessible.
Clybourn place	Highway		100.0		do	Bascule under construction.
Webster avenue	do	55.0		58.0	Hand	
C. & N. W. Rwy	Railway	60.0		60.0	Steam	
Fullerton avenue	Highway			53.0	Electy	Left draw inaccessible.
Diversey boulevard	do	53.0		71.0	Hand	
N. W. avenue	do	64.0		66.0	do	Kept open for navigation; right draw inaccessible.
Belmont avenue	do	43.0		43.0	do	Head of navigation.
NORTH BRANCH CANAL.						
N. Halsted street	Highway	51.3			do	Right draw inaccessible.
Division street	do		80.0		Electy	Bascule under construction.
Weed street	do		53.0		Hand	Jackknife type. Kept open for navigation.
C., M. & St. Paul Rwy	Railway	47.0		48.5	Horse	

* Right and left refer to sides when looking toward the lake.

RULES AND REGULATIONS.—The following extracts having reference to the control of the river, relative to navigation, by the city of Chicago, were obtained from the Revised Code of Chicago, 1897. The numbers given within parentheses correspond to numbers in the Revised Code alluded to:

Article 1. Harbor defined.

(791) The harbor shall consist of the Chicago River and its branches to their respective sources, including that portion known as the Ogden Canal, and all slips adjacent to and connecting with the Chicago River, the piers and basins, including the waters of the Government breakwater which lie adjoining to and extending 3 miles into the lake between the north and south lines of the city, and all the territory embraced between the limits of said survey as aforesaid shall be a portion of the harbor of the city of Chicago, and shall be subject to the control of the harbor master and to all the rules and regulations of this chapter or which shall be hereafter provided by the city council. The words "vessel," "crafts," and "floats" shall be deemed to include every species of steam and other vessels lying, or floating in, or navigating the harbor.

Article 2. Bridges, control of.

(207) *Bridges closed, hours.*—No bridge within the city of Chicago, except on Sundays, shall be opened during the times herein specified:

1. Across the main river and across the south branch of the Chicago River, from its junction with the main river and as far south as Twelfth street, including the latter, and across the north branch of the Chicago River at Kinzie street, between the hours of 6 and 8 o'clock in the morning and 5 and 7 o'clock in the evening.

2. Across the north branch of the Chicago River from Kinzie street, exclusive, to Halsted street, inclusive, and across the south branch of the Chicago River from Twelfth street, exclusive, to Halsted street, inclusive, between the hours of 6 and 7 o'clock in the morning and half past 5 and half past 6 in the evening.

3. All other bridges between the hours of 6 and 7 o'clock in the morning and 6 and 7 o'clock in the evening.

The provisions of this section are not to apply to "low bridges," or those under which tugs can not pass.

(208) *Time to remain open.*—During the hours between 6 o'clock in the morning and 12 o'clock, midnight, it shall be unlawful to keep open any bridge within

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the city of Chicago for the purpose of permitting vessels or other craft to pass through the same for a longer period, at any one time, than ten minutes, at the expiration of which period it shall be the duty of the bridge tender, or other person in charge of the bridge, to display the proper signal and immediately close the same and keep it closed for fully ten minutes for such persons, teams, or vehicles as may be in waiting to pass over, if so much time shall be required, when the said bridge shall again be opened (if necessary for vessels to pass) for a like period, and so on alternately (if necessary) during the hours last aforesaid; and in every instance where any such bridge shall be opened for the passage of any vessel, vessels, or other craft, and closed before the expiration of ten minutes from the time of opening, said bridge shall then, in every such case, remain closed for fully ten minutes, if necessary, in order to allow all persons, teams, and vehicles in waiting to pass over said bridge: *Provided*, This section shall not be construed as being in conflict with section 207 hereof, nor as requiring the opening of the bridges during the time specified in said section for the same to remain closed: *Provided, however*, That all vessels having passed through State Street bridge going out previous to closing the bridges for two hours, morning and evening, be permitted to pass through Rush Street bridge out to the lake.

(209) *Open for vessels ten minutes.*—Bridge tenders or persons in charge of the bridges shall not close the same against vessels seeking to pass through until passengers, teams, or vehicles have been delayed fully ten minutes by the bridge being open.

Article 3. Steamboat signals, etc.

(204) *Vessel signals.*—The commissioner of public works is hereby required to provide and maintain at the several bridges over the Chicago River and its branches, in the best and most practicable manner, vessel signals as required by this article.

(205) *Signals prescribed.*—Said signals shall be of material of a red color for use in the daytime and shall be of such size and so placed, when elevated, that they may be readily seen up and down the river. The signal for the nighttime shall be a red lantern of such size and so placed and arranged, when elevated, as to be easily seen up and down the river and the street.

(206) *Duty of vessels.*—It shall be unlawful for the owner or owners, officer or officers, or other person or persons in charge of any vessel or vessels navigating the Chicago River or its branches, or any part thereof, to attempt to pass any of the bridges over the said river or its branches while said signal or signals are up or elevated, or to approach nearer than the end of the bridge protection to any of said bridges at such times as that the same may be injured or damaged, or while the said bridges, or any of them, may be opening or closing.

(1953) *Steamboat whistles.*—No person shall blow or cause to be blown the steam whistle of any steamboat, wharf boat, tug, or other boat, for any purpose whatever, while lying at anchor at any wharf or dock in said city, or when approaching or leaving such wharf or dock, or when passing through any drawbridge in said city, from the time such boat shall have entered the approach to such bridge until it shall have passed through said drawbridge and beyond the opposite approach, or when running in the Chicago River or any of its branches in said city, except when absolutely necessary as a signal of danger, and in cases and under circumstances prescribed by the laws and regulations of the United States requiring the use of such whistles.

(1956) *Signals to bridge tenders—Size of whistles.*—All boats in passing or repassing up and down upon the Chicago River or any of its branches may use a steam whistle to signal bridge tenders to open and swing bridges, and such signal shall be given by three sharp short sounds of the whistle, to be given in succession as quickly as possible, and not to be prolonged, and the whistle used for this purpose shall be of copper, the tube not less than 13 inches long, 8 inches in diameter, and the steam pipe not more than 1 inch in diameter.

Article 4. Discharge of cargoes.

(787) *Cargo—Discharge.*—No persons discharging the cargo of any vessel, craft, or float shall suffer any part of such cargo to remain projecting over the front of any wharf after such vessel, craft, or float shall remove from the wharf, under a penalty, to be recovered from the master, owner, or other person having charge of such vessel, craft, or float occupying such wharf, of $10 for every hour such projection shall continue.

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Article 6. Obstructions to river.

(779) *Locate vessels—Forbidden location—Penalty.*—The harbor master shall give such orders and directions relative to the location, change of place or station, manner of moving or use of the harbor of every vessel, craft, or float lying, moving, or laid up in the harbor, as may be necessary to promote good order therein and the safety and equal convenience of such vessels, crafts, or floats. No steamboat, vessel, or other craft shall make fast to or lay alongside of another, or lap one another, in that portion of the harbor between Rush Street bridge and Wells street in the main river, between Lake Street bridge and Halsted street in the south branch, and between Kinzie Street bridge and North avenue in the north branch, contrary to the orders of the harbor master. It shall also be unlawful for any mud scow, flatboat, dredge, or any such crafts to be placed or laid alongside of another while lying at any of the docks or wharves of the harbor during the navigable season of the year, without first having obtained permission from the harbor master. Any owner, master, or other person having charge of the same, who shall refuse or neglect to obey any such order or direction, shall be subject to a penalty of not more than $25 for every such neglect or refusal.

(780) *Power over vessels—Refusal to obey.*—Whenever there shall be in the harbor any vessel, craft, or float insecurely fastened, adrift, sunken, or laid up, which may be required to be fastened, raised, removed, or its location changed, for the benefit of other vessels navigating the river, the harbor master shall notify the owner, master, or other person who may be in charge thereof, to secure, raise, or remove such vessel, craft, or float without delay. But if the harbor master should be unable to find the master, owner, or person in charge of such vessel, craft, or float as aforesaid, or if no person answering such description can be found by him, such notice shall not be required, and the harbor master shall remove such vessel and said vessel shall be held for all expenses and costs, and any person who shall refuse or neglect to comply with such order or direction shall be subject to a penalty of not more than $25, and a further penalty of $10 for every hour he or they shall refuse or neglect to observe the same.

(781) *Removals, etc., at expense of owner.*—If any vessel, craft, or float shall not be secured, removed, or its location changed in compliance with the direction of the harbor master after notice, or if the harbor master shall be unable to serve such notice, as aforesaid, in either case he shall cause such vessel, craft, or float to be secured, raised, removed, or its location changed, as aforesaid, employing such assistance as may be necessary for the purpose. All expenses which may be incurred in any case shall be recoverable of the owner, consignee, master, or other person having charge of such vessel, craft, or float. If any person shall resist the harbor master, or any person acting under him, in the execution of any duty imposed upon him by this chapter, such person so resisting shall be subject to a fine of not less than $10 and not exceeding $100.

(782) *Stop at south pier limited—Penalty.*—No master, owner, or any person in charge of any vessel, craft, or float shall cause or suffer the same to remain at or within 100 feet of the south pier for a longer period than is actually necessary to furl sail on coming in or make sail on departing, under a penalty of $10: *Provided*, That rafts or vessels necessarily used in the construction or repair of the piers shall not be deemed to be within this provision.

(783) *Vessels blocking passage—Injury to bridge.*—No vessel, craft, or float shall be so moored or anchored within the harbor or in any slip or at any dock as to prevent the passage of any other vessel, craft, or float; nor shall any craft, vessel, or float be so moored as to range against or injure any bridge across the river, or any branch thereof, under a penalty of not less than $10 nor exceeding $100, to be recovered from the master, owner, or person in charge thereof, for each offense.

(784) *Speed at bridges—Forbidden anchorage.*—All vessels, crafts, or floats navigating the harbor, when passing any bridge, shall be moved past the same as expeditiously as is consistent with a proper movement in the harbor, but in no case shall any vessel, craft, or float, while passing any bridge, and obstructing the passage across such bridge, move at a rate of speed less than 2 miles per hour; and no vessel, craft, or float shall be so anchored or fastened as to prevent any bridge from a free and speedy opening, or any ferryboat from a free and direct passage, nor shall any line or fastening be so thrown, laid, or made fast

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as to cross the track of any bridge or ferry under a penalty of not more than $25 for each offense, to be recovered from the master or other person having charge of such vessel, craft, or float.

(796) *Lumber raft—Obstruction.*—Any person or persons having in charge any raft of lumber, logs, or timber, who shall refuse or neglect to comply with the orders of the harbor master relative to the change of location or removal of the same, shall forfeit and pay, on conviction thereof, the sum of not more than $50 and the cost of prosecution. And any owner, master, or officer of any tug, propeller, or steamboat leaving any such raft of lumber, logs, or timber within the harbor, where the same shall be or become an obstruction to commerce, shall, on conviction thereof, be fined not more than $100 for each and every offense.

(798) *Removal of vessel—Tying up.*—The harbor master shall have the power to move any vessel, craft, or float, while lying at any dock, wharf, or pier, while receiving or discharging cargo or otherwise engaged, when in his judgment it is necessary so to do to facilitate the movement of other vessels, crafts, or floats; he shall also have power when, in his judgment, a vessel is so deeply loaded as to interrupt the traffic at the bridges or in the harbor, to tie up such vessel until such time as the said vessel shall have been lightened or a rise in water in the river may enable her to proceed; also to stop at any time or place such vessels, crafts, or floats as may be proceeding up or down the river, so as to prevent a jam or blockade.

Article 7. Rules for navigation.

(785) *Steam tug for sailing vessels.*—All vessels, crafts, or floats not propelled by steam, navigating the harbor, for which the opening of any bridge may be necessary, shall, while approaching and passing such bridge, be towed by a steam tug, under a penalty upon the master, owner, or person in charge thereof of not less than $25 nor exceeding $100.

(786) *Vessel moved to bridge before opening.*—Whenever any person having charge of any vessel, craft, or float, shall wish to move the same past any ferry-boat or bridge, reasonable time shall be allowed for the opening of the same, and any person who shall move any vessel, craft, or float against any bridge or ferry or the draw of any bridge before the same shall be open, to the injury thereof, shall be subject to a fine not exceeding $200 and be, likewise, answerable to the city of Chicago for damages.

(788) *Rules for navigation.*—All vessels, crafts, or floats lying in or navigating the harbor shall be respectively governed by the following further provisions:

1. All vessels using steam shall have their smoke pipes so constructed and managed as to prevent sparks or coals of fire escaping therefrom, and shall be moved slowly at a speed not exceeding 4 miles per hour under a low head of steam. All tugboats or steam vessels used chiefly for towing shall have a joint in their smoke pipes, and shall be constructed in all respects in such a manner as to be able to pass under any bridge which is not less than 13 feet above the surface of the water.

2. No master or other person owning or having charge of any vessel, craft, or float shall leave the same in the harbor without having on board or in charge thereof some competent person to control, manage, and secure the same, without first obtaining permission of the harbor master.

3. No vessel laden in whole or in part with gunpowder or gun cotton shall land at or make fast to any dock or wharf upon Chicago River, or either branch thereof, between the south line of the school section and Chicago avenue, or discharge such gunpowder or gun cotton within said limits. The harbor master shall prevent any vessel with gunpowder or gun cotton on board from making fast to any wharf or dock, or unloading, within the limits aforesaid.

4. All vessels, crafts, or floats, whether using steam or otherwise, while in the harbor, shall have and keep their anchors on board, and their lower yards cock-billed, and their upper yards braced up sharp.

5. They shall likewise have and keep out on board during the nighttime a conspicuous light, and shall have extinguished or safely secured at dark all fires which may be kept on board.

6. No vessel, craft, or float shall be suffered to lie in the harbor adrift or insecurely fastened.

7. Any master, owner, or other person having charge of any such vessel, craft, or float shall be subject to a fine of not less than $20 nor exceeding $100 for every

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violation of any provision of this section, and to like fine for every refusal to conform thereto when directed by the harbor master.

(792) *Improvement of harbor—Hindrance.*—If any owner or master or other person in charge of or in command of, or sailing any tugboat or towing boat in and upon the Chicago River, or any of the branches of said river, or upon Lake Michigan within said city limits, shall run, sail, or cause to be run or sailed such tugboat or towing boat, or anything that they may have in tow, upon, against, or over any rope, chain, or other fastening, mooring dredge or other machine used by said city for deepening, widening, and improving said lake and said river and its branches, so that the said dredge or other machine shall be displaced, hindered, or delayed in the working thereof, such person so offending shall be fined not less than $10 nor more than $100 for such offense.

(797) *Steam vessel—Working engine.*—No steam vessel while lying in the harbor or along the wharves or docks of the same shall work its engines previous to leaving the harbor: *Provided*, That owners, masters, or other persons in charge of boats fitting out and desirous of working and testing their engines shall, before working or testing such engine, station some person in such a place or position as to signal the engineer to stop such engine; said engine shall be kept from working until all approaching vessels, crafts, or floats shall have passed the wheel of said boat or boats a distance of 200 feet. This shall not apply to cases of fire. Any person or persons violating any provisions of this section shall be fined not less than $20 nor more than $50 for each and every offense; and shall also be liable for any damage to persons or property sustained by reason of such violation.

(799) *Limit of towage—Danger signal—Speed in passing.*—It shall be unlawful for any steamboat, steam tugs, or steam canal boats to tow more than four canal boats, barges, or scows in one tow within the limits of said harbor. All docks, wharves, bridges, piers, protections, or other place where person or property is in danger by the fast moving of steamboats or tugs shall have a blue flag flying in the most conspicuous place thereon and as near the point of danger as possible, so as to be seen from up or down the river, and at night a blue light shall take the place of such flag; and any owner, master, or other person in charge of steamboat or tug running or causing to be run any steamboat or tug past such a blue signal faster than at the rate of 2 miles per hour, or violating any other provision of this section shall, upon conviction thereof, be fined not less than $25 nor more than $50 for each and every offense, and shall be held liable for any damage to person or property sustained by reason of such violation.

(1766) *Anchor dragging.*—Hereafter all vessels, crafts, or floats navigating the Chicago River or either of the branches thereof, or any of the slips on said river, or either of said branches, whether using steam or otherwise, are expressly prohibited from dragging their anchors in any part of the Chicago River, or either of its branches or slips.

(1768) *Penalty.*—Any person or persons having charge or control of any such vessel, craft, tug, or float who shall violate any of the provisions of this chapter shall be liable to a fine of not less than $50 nor exceeding $100 for each and every violation; and all such persons, as well as the owner or owners of such vessels, crafts, tugs, or floats shall be liable for all damages accruing by reason of the violation of this chapter, or any of the sections or provisions thereof.

Charts: Lake Front, Chicago, including Calumet Harbor; Coast Chart No. 4, Lake Michigan; South End of Lake Michigan; Lake Michigan.

CHICAGO SANITARY AND SHIP CANAL. Distance from mouth of Chicago River to junction of main channel of Canal with West Fork of South Branch of Chicago River at Robey street, about 6 miles. Length of main channel, Robey street to controlling works at Lockport, 28.05 miles. Dimensions: Robey street to Summit, 7.8 miles, 110 feet wide at bottom, 198 feet wide at water line, with minimum depth of water, 22 feet. Summit to Willow Springs, 5.3 miles, 202 feet wide at bottom, 290 feet wide at water line, with 22 feet depth of water; at Willow Springs the channel narrows to the walled and rock cross section, extending 14.95 miles to Lockport, 160 feet wide at bottom, 162 feet wide at top. The velocity in earth is figured for 1½ miles per hour and in rock 1.9 miles per hour.

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(For description of the operations of the Sanitary District of Chicago in the Chicago River, between Lake Michigan and Robey street, see Chicago River.)

Bridges.

No.	Name of bridge.	Kind.	Draw opening in the clear.			Height of lowest chord above C. D.
			Left.*	Center.	Right.*	
			Feet.	*Feet.*	*Feet.*	*Feet.*
1†	Southwest boulevard	Highway	{ 71 / 89 }	-------	{ ‡ / 89 }	16.38
2†	Panhandle	Railway	Fixed.	120	Fixed.	16.00
3†	C., M. & N. (Ill. Cen.)	do	75	-------	‡	18.50
4†	Kedzie avenue	Highway	75	-------	‡	16.50
5†	A., T. & S. F. (26th street)	Railway	75	-------	‡	17.44
6†	C. & W. I. Belt Railway	do	70	-------	‡	16.58
7†	A., T. & S. F. (Lemoyne)	do	75	-------	‡	18.17
8§	Lyons road	do	85	-------	85	18.00
9§	C. T. T. Railway	do	84	-------	84	17.62
10	Willow Spgs. road	Highway	162	-------	Bobtail.‡	17.75
11	Romeo road	do	162	-------	-------	16.25
12	A., T. & S. F. (Lemont)	Railway	162	-------	Bobtail.‡	17.27
13	Lemont road	Highway	162	-------	Bobtail.‡	16.75

*Going in a southwesterly direction (from the lake).

†The bridge is built for two draws, but only one (the left) has been dredged and made available as yet.

‡Not accessible.

§Both draws available for boats that can pass under the bridge.

All the bridges are swing bridges (except No. 2, which has a bascule bridge across the center span and one fixed span on each side) and they are so built that they can be operated when required, the only thing now lacking to their construction being the motive power; the law allows the district to keep them closed and operated as fixed structures for a period of seven years dating from January 17, 1900. At the expiration of that period they must be equipped with operating machinery and go into service as movable bridges, and then this channel will be a free waterway, navigable for any craft drawing less than 22 feet of water.

On December 5, 1901, the Secretary of War granted permission to the Sanitary District of Chicago to so regulate the discharge of water into the Chicago Drainage Canal that the maximum flow through the Chicago River shall not exceed 250,000 cubic feet per minute throughout the twenty-four hours of the day.

Charts: Lake Front, Chicago, including Calumet Harbor; Coast Chart No. 4, Lake Michigan; Lake Michigan.

CHICAGO TO THE MISSISSIPPI RIVER BY WAY OF THE ILLINOIS AND MICHIGAN CANAL AND THE ILLINOIS RIVER. Distance, 325.24 miles (from Lake Michigan), 5 miles in the Chicago River, 97.24 miles in the Illinois and Michigan Canal, and 223 miles in the Illinois River from Lasalle to mouth. The Illinois and Michigan Canal commences on the South Branch of the Chicago River, 5 miles from Lake Michigan. There are fifteen lift locks and one guard lock. The canal was intended to be 60 feet wide at the water surface, 48 feet wide on the bottom, with locks 110 feet long, 18 feet wide, and having a depth of 6 feet on the miter sills. There are four locks in the Illinois River between Lasalle and the Mississippi, each 350 feet long, 75 feet wide, with 7 feet depth on the miter sills. The first two below Lasalle (one at Henry, 196 miles above the mouth, and one at Copperas Creek, 137 miles above the mouth) are operated by the State of Illinois, and tolls are collected. The other two (one at Lagrange, 79 miles above the mouth, and one at Kampsville, 31 miles above the mouth) are operated by the United States.

Charts: Lake Front, Chicago, including Calumet Harbor; Coast Chart No. 4, Lake Michigan; South End of Lake Michigan; Lake Michigan.

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CROSS VILLAGE, MICH. (EAST SHORE OF LAKE MICHIGAN, NEAR STRAITS OF MACKINAC). A substantial pier has been constructed by private enterprise. In front and to the eastward of the village the water deepens rapidly; to the westward the water remains shoal for a long distance out, the shoal water commencing just in front of the village and extending westward 1½ miles, or until well past the general coast line of the reach above the village. Vessels in making a landing keep well to the north, and approach the pier from the northwest. It is well protected from the south, and from the north and northeast it is partially protected by Waugoshance Point and Reef. It is entirely without shelter from the northwest and southwest, and the seas, having a long clear sweep, beat directly upon the beach in front of the village. Under such circumstances vessels do not attempt to land, neither do they when the gale is severe from the north or west, as the reef to the north and the Beaver Islands to the west serve to only partially shelter the wharf. Vessels loading in this locality, if overtaken by severe weather, are obliged to seek shelter in the lee of the neighboring islands. In 1883 the pier projected 700 feet beyond the shore line with 14 feet of water at the end of the pier. No later information available.

Charts: Beaver Island Group; North End of Lake Michigan; Lake Michigan.

CRYSTAL LAKE, MICH. (ON EAST SHORE OF LAKE MICHIGAN, 2 MILES NORTH OF FRANKFORT). Length, about 8 miles; breadth, about 2 miles. It is only ¼ mile from Lake Michigan, but many feet above it. It is surrounded by high hills, and has no visible inlet. Near the middle it is several hundred feet in depth. It has an outlet into Betsie River, open at times, but generally closed. Were this lake on a level with Lake Michigan, and a communication practicable, a magnificent harbor could be made.

Charts: Coast Chart No. 9, Lake Michigan; North End of Lake Michigan; Lake Michigan.

DOUGHERTY HARBOR, MICH. *See* Grand Traverse Bay.

EAST TWIN RIVER, WIS. *See* Two Rivers.

EMPIRE BAY, MICH. A bight of navigable water about 10 miles across, formed by shoals jutting out in a westerly direction from Sleeping Bear Point as a northern and Empire Bluffs as a southern limit. The locality is dangerous for vessels wending northward with too much easting in a gale of wind. No harbor facilities are known to exist.

Charts: Grand and Little Traverse Bays; North End of Lake Michigan; Lake Michigan.

ESCANABA, MICH. Situated on the west shore of Little Bay de Noquette, north end of Green Bay. A good natural harbor. Extensive ore docks and wharves have been built and slips adjacent thereto constructed by railway and other corporations.

Charts: North End of Green Bay; North End of Lake Michigan; Lake Michigan.

FOX ISLANDS, MICH. The holding ground around these islands is good. On the east side of the islands the water is deep. A recent survey showed the existence of several shoal spots south of South Fox Island at points where the original published charts indicated depths of 5 to 9 fathoms, and a new large-scale chart has been issued.

Charts: South Fox Island Shoals; Grand and Little Traverse Bays; North End of Lake Michigan; Lake Michigan.

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FOX RIVER, WIS. The distance from Green Bay to the Mississippi River by way of the Fox and Wisconsin rivers is 281 miles; maximum draft is limited at low water by depths on the Wisconsin; soundings, September 4, 1896, showed a depth of but 2 feet on the bars near its mouth. The Wisconsin River improvement was abandoned in 1887. Its high slope (18 inches per mile) causes velocities too great for control in a navigable channel, through its bed of shifting sand. The crookedness of the channel, taken in connection with the shifting nature of the channelway and the current of the stream, make navigation for vessels of the length adapted to the locks on the Fox River nearly impossible even if sufficient depth of channel existed. The distance on the Fox River, from Green Bay to Portage on the Wisconsin, is 163 miles. The rise from Green Bay to the level of Lake Winnebago at Menasha, 35 miles, is about 170 feet; there are eighteen locks on this section, with available length varying from 157.2 feet to 168.2 feet, clear width from 34.8 feet to 40 feet, and depth over lower sills from 6 feet to 11.7 feet. From Menasha through Lake Winnebago to Oshkosh, where the Fox River enters that lake, the distance is 18 miles. From Lake Winnebago to Portage City, 110 miles, the rise is about 30 feet; there are nine locks on this section with available length varying from 158.2 feet to 168.6 feet, clear width from 34.5 feet to 35.7 feet, and least depth on lower sills, from 5 to 11.14 feet. *June 30, 1901.*—The maximum draft that can be carried at mean low water over the shoalest part of the Fox River improvement is, from Depere to White River Lock, 6 feet; from that point to Montello, 4 feet; and from Montello to Portage, 3 feet.

REGULATIONS prescribed by the Secretary of War, February 15, 1895, January 29, 1896, and July 21, 1900, for the use, administration, and navigation of locks and canals, Fox River:

1. *Authority of canal officers.*—The movement of all boats and floating things in the canals, the locks, and the approaches to the canals shall be under the direction of the engineer in charge of the Fox River Improvement, or his duly authorized agents.

2. *Signals.*—All boats approaching the locks shall signal for the same by four distinct whistles of short duration.

3. *Precedence at locks.*—Ordinarily, the boats or tows arriving first at any of the locks shall have precedence in passing, but in all cases boats and barges belonging to the United States, or employed upon public work, shall have the precedence over all others; and passenger boats shall have the precedence over tows. Rafts shall have one lockage in their turn, except where there are two or more rafts together at a lock, in which case no part of a raft shall pass the lock until the whole of the raft or rafts preceding it shall have passed. All small vessels or craft, such as skiffs, sculls, sailing boats, etc., bent on pleasure only, shall not be granted a separate lockage, but may be passed through locks in company with vessels legitimately engaged in commerce, or to the number of not less than six at one lockage.

All boats, etc., arriving at the locks and not taking advantage of the first lawful opportunity to pass, shall lose their turn.

4. *Mooring in locks.*—All boats when in the locks shall fasten one head line and one spring line to the snubbing posts on the lock walls. Large boats shall use one head line and two spring lines, and the lines shall not be unloosed until the signal is given by the lock tender for the boat to leave the lock.

5. *Delays in canal.*—No boat, barge, raft or other floating craft shall tie up or in any way obstruct the canal or its approaches or delay entering or leaving the locks, except by permission from proper authority. Boats wishing to tie up for some hours or days in the canal must notify the officer in charge, through the lock tender, and proper orders in the case will be given. Boats so using the canal must be securely moored in the places assigned them, and if not removed promptly on due notice will be removed at the owner's expense by the canal officers.

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6. *Injury to locks or fixtures.*—Boats shall use great care not to strike any part of the lock or sluice walls, or any gate or appurtenance thereto, or machinery for operating the gates, or the walls protecting the banks of the canal.

All boats using the canal shall be free from projecting irons or rough surfaces that would be liable to damage the locks or any part of the canal, and they must be provided with fenders to be used in guarding the lock walls, etc., from injury.

7. *Handling gates.*—No one, unless authorized by the lock tender, shall open or close any gate or wicket, or in any way interfere with the employees in the discharge of their duties; but the lock tender may call for assistance from the master of any boat using the lock should such aid be needed.

8. *Draught of boats.*—No boat shall enter the canal or locks whose actual draught exceeds the least depth of water in the channel of the canal as given by lock tender.

9. *Right of way.*—Boats going down stream shall have the right of way over boats going up stream. Rafts must give to steamers the side demanded by a proper signal.

Boats must not race or crowd alongside of each other while under way in the canal. If a boat meets a boat and tow on opposite sides of a lock, and the boat with tow has the privilege of one lockage, the other boat shall have the next lockage.

A boat and barge arriving at a lock and another boat overtaking them before the second of the two has entered the lock, the boat so overtaking shall have the privilege of the second lockage.

10. *Boats and rafts without steam.*—No raft or boat shall be brought through the canal unless accompanied by a steamboat, except small boats controlled by sails or oars.

11. *Refuse in canals.*—No person shall roll or throw any stones, ashes, cinders, or other material into the canal or locks, or place any such material on any bank or berm of the canal so that it is liable to be thrown or rolled in.

12. *Drawing off water.*—The object of the improvement, whether by canal or by operations in the natural river and its lakes, being to secure a navigable depth of water in the improved channel, and any action lowering the water surface below the levels established by the dams to secure such depth, being the creation of an obstruction to the navigable capacity of this channel, no water shall be drawn by any party or parties from any portion of the Fox River canals, or of the Fox River including its lakes, improved channels and unimproved channels, to such extent as to lower the water surface at the dam next below the place where such draft of water is effected below the crest of that dam.

13. *Obstructing navigation.*—Anyone who shall willfully or through carelessness in any way obstruct the free navigation of the canal or, by the violation of any of the laws or regulations governing the canal and those using it, delay or inconvenience any boat having the right to use the canal, shall be responsible for all damages and delays, and for all expenses for removing the obstructions.

14. *Commercial statistics.*—At the end of each month, during the season of navigation, masters or clerks of boats shall furnish, in writing, to the engineer in charge, or his duly authorized agent, a monthly statement of passengers and cargo carried.

15. *Vessel or craft sinking in canal.*—In case of any boat, vessel, or other craft, or raft, sinking or grounding in the canal, or otherwise obstructing it, the officer, or agent, of the United States in charge of the canal, shall have the right to take such possession of such vessel, boat, or other craft, or raft, as shall be necessary for the purpose, and remove it, and clear the canal of the obstruction caused by it, and no one shall interfere with or prohibit him from doing so; or do anything that will tend to interfere with, or prohibit him from doing so; *Provided*, That the officer, or agent, of the United States may, in his discretion, give notice in writing to the owners of any vessel, boat, or other craft, or raft, obstructing the canal as aforesaid.

16. *Protection of lock gates.*—Boats will not be permitted to enter or leave the locks until the lock gates are fully in the gate recesses, and the lock-tender has directed the boat to start.

17. *Trespass on lock property.*—Trespass on lock property, or injury to the entrance, banks, cribs, locks, fences, trees, houses, shops, or any other property of the United States pertaining to the locks, is strictly prohibited.

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les and regulations provided by U. S. or local authorities for opening.	Remarks.
S. and Railway Co	Located about 25 feet below Depere lock and crossing tail walls.
	Continuation of drawbridge.
S. and city	
	Continuation of drawbridge.
S. and village of Wrightstown	Fixed spans are approaches to draw.
S. and Railway Co	Crosses lower wing walls of second lock, and right approach rests on same. Stage of water in canal controlled by U. S.
S. and city	
	Continuation of drawbridge.
S. and city	
	Continuation of drawbridge.
S. and village of Little Chute, Wis	Bridge crosses first lock and rests on walls of same.
	Continuation of drawbridge.
S. and city	
	Continuation of drawbridge.
S. and Railway Co	Located 350 feet below third lock.
	Located below Lawe Street highway bridge.
S. and city	Stage of water in canal controlled by U. S.
	Bridge crosses river below Pearl street.
S. and city	
	There are 23 spans in river proper and 9 spans in water-power canal, one being practically closed by breakwater; located between upper and middle dams.
	Do.
S. and Railway Co	Both draws available, but right draw seldom used; located above first lock; pile and crib approaches.
	Private wagon bridge.
S. and W. C. Railway Co	Crosses canal at Lush street.
	Crosses river at Lush street (continuation of drawbridge).
	Main line crossing river above W. C. R. R. bridge.
S. and city	
	Continuation of drawbridge.
	Private wagon bridge crossing river above Tayco street.
	Crosses river below Menasha dam.
S. and city	
	Continuation of drawbridge.
	Pile bridge 1,441.8 feet long, with 1,250 feet of causeway on right; crossing Lake Butte des Morts.
	Crosses south channel at River street.
	Located between Commercial street and Neenah dam.
S. and Railway Co	At Broad street. Fixed spans are approaches to draw.
S. and city	Fixed spans are approaches to draw.
S. and city	Fixed spans are approaches to draw.
S. and Railway Co	Crosses river opposite Pine street. Fixed spans are approaches to draw.
S. and city	Fixed spans are approaches to draw.
S. and city	Fixed spans are approaches to draw.
S. and village	Fixed spans are approaches to draw.
S. and Railway Co	Fixed spans are approaches to draw.
S. and town of Rushford	Fixed spans are approaches to draw.
, city of Berlin, and town of Aurora	Located 1 mile below Huron Street bridge. Fixed spans are approaches to draw.
S. and city	
S. and Railway Co	Located ½ mile below Main Street bridge. Fixed spans are approaches to draw.
S. and village	Fixed spans are approaches to draw.
S. and town board	Draw crosses Montello lock and rests on walls of same.
	Continuation of drawbridge.
S. and village board of Packwaukee	Pile bridge with ponton draw and 1,527 feet of causeway crossing Buffalo Lake.
S. and town board of Moundville	Pile bridge with ponton draw located at M. P. 95.
S. and town board of Fort Winnebago	Located ⅛ mile above new M. P. 98.
S. and Railway Co	Jackknife draw, 1,700 feet above M. P. 102.
S. and Railway Co	"Old Line" crossing.
S. and city	
S. and Railway Co	"Main Line" crossing, near Center avenue.
S. and city	

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FRANKFORT, MICH. On the east shore of Lake Michigan, about 4 miles south of Point Betsie light. The harbor is formed by Lake Betsie, or Aux Becs Scies, which is connected with Lake Michigan by a channel protected by piers and revetments. In 1859 there were rapids in the natural outlet of Lake Betsie with a depth of 2½ feet in the vicinity. Shortly afterwards a cut, protected by piers, was made near the outlet by private enterprise, and is said to have afforded a narrow and crooked channel, with a depth of 10½ to 11 feet, which soon shoaled and became useless for navigation.

The work of improvement was commenced by the United States in 1867 under a plan for making a new cut between Lake Michigan and Lake Betsie, at a point about 750 feet south of the old outlet, with protecting piers extending into Lake Michigan. The present project provides for a channel 18 feet deep and 200 feet wide, protected by suitable piers and revetments. There are two piers 200 feet apart in the clear; the total length of the north pier and revetment is 1,700 feet, and that of the south pier and revetment is 1,988 feet. The north pier projects 910 feet beyond the shore line, and the south pier 1,540 feet beyond the shore line, and 230 feet beyond the end of the north pier. The piers and revetments are parallel. The channel connecting Lake Michigan and Lake Betsie is straight and easily navigated, 1,940 feet long, with a depth of 18.6 feet; its direction is about S. 85° E. It is sometimes obstructed at the entrance by a shoal which is constantly reformed by northerly storms after dredging, and which usually occupies approximately the northern half of the channel at its outer end, but there is always a depth of about 18 feet for a width of 80 to 100 feet next to the outer end of the south pier. Inside this point the 18-foot channel has a width of 60 feet and occupies the central part of the channel. Lake Aux Becs Scies is about 1½ miles long and 1,000 to 2,000 feet wide. It is generally shoal but affords a depth of about 20 feet in its lower portion. There is no basin at this harbor other than that afforded by Lake Aux Becs Scies, and no bridges obstruct navigation. No harbor regulations exist.

Charts: Coast Chart No. 9, Lake Michigan; North End of Lake Michigan; Lake Michigan.

GLADSTONE, MICH. Situated on the west shore of Little Bay de Noquette, north end of Green Bay. A good natural harbor. Extensive ore docks and wharves have been built, and slips adjacent thereto constructed by railway and other corporations.

Charts: North End of Green Bay; North End of Lake Michigan; Lake Michigan.

GLEN ARBOR, MICH. (ON SLEEPING BEAR BAY, EAST SHORE OF LAKE MICHIGAN, SOUTH OF NORTH MANITOU ISLAND). Has shelter from west through south to northeast winds. Depth 14 to 15 feet at landing, which is a private pile pier about 400 feet long.

Charts: Manitou Passage; Grand and Little Traverse Bays; North End of Lake Michigan; Lake Michigan.

GLEN HAVEN, MICH. On westerly shore of Sleeping Bear Bay, east shore of Lake Michigan. Affords shelter from west through south to northeast winds. There is a depth of 14 feet at Day's Dock.

Charts: Manitou Passage; Grand and Little Traverse Bays; North End of Lake Michigan; Lake Michigan.

GRAND HAVEN, MICH. On the east shore of Lake Michigan, about 12 miles SSE. of the harbor of Muskegon, and at the mouth of Grand River, the largest

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river lying wholly in the State of Michigan. Before improvement the natural depth upon the bar at the mouth of the river varied from 9 to 12 feet, with much greater depths further inside and outside. The channel of best depth was unstable in character, due to the light sand of which the obstructing bar was composed. The present project provides for a channel 18 feet deep protected by parallel piers and revetments 400 feet apart. The total length of the north pier and revetment is 3,538 feet, and of the south pier and revetment 5,774 feet. The north pier projects 1,490 feet, and the south pier 1,770 feet, beyond the shore line. The clear width between the piers is 415 feet at the entrance, diminishing to 390 feet inside. The channel between the piers bears approximately N. 82° 10′ E. 2,250 feet, then approximately N. 62° 20′ E. toward Grand Haven. Outside of the entrance a central bar usually exists with sometimes as little as 14 feet of water over its shoalest point; but the approaches to the entrance, north and south of the bar, always have greater depths. On March 20, 1902, the depth on the shoalest point of the bar was 15.3 feet, at about 350 feet west of the end of the piers, and about 100 feet north of the prolongation of the south pier, while the available depth on the southern approach to the entrance was not less than 20 feet, and on the line of the north pier 19.8 feet. Upon a line at right angles to the north pier at its outer end, the channel afforded a depth of 18 feet for a width of 180 feet next to the south pier, 17.7 feet in the middle, and 18 feet for a width of 170 feet next to the north pier. Further inside, there is a depth of 20 feet or more to the Grand Haven landing, and width of 120 feet next to the south pier and revetment. Deep-draft vessels should ordinarily use the southern approach in entering and leaving the harbor. No basin exists at this harbor. The channel opposite Grand Haven is wide and deep enough for winding.

About 2 miles above the harbor is Spring Lake, connected with Grand River at Ferrysburg by a narrow channel 12 feet deep. This lake is about 4½ miles in length and 700 to 2,000 feet wide; the channel at its mouth is crossed by two bridges—the highway bridge, east or left opening 51 feet, west or right opening not accessible; and the Detroit, Grand Haven and Milwaukee Railroad bridge, east or left opening 52 feet, west or right opening not accessible. The highway bridge has a red light in the center and a white light at each end, height above water 13½ feet. The railroad bridge has a red and green light at each end of the draw 15 feet above water. Grand River, which empties into Lake Michigan at Grand Haven, is described under a subsequent heading.

No harbor regulations are in force at this harbor.

Charts: Coast Chart No. 7, Lake Michigan; South End of Lake Michigan; Lake Michigan.

GRAND RIVER, MICH. (BELOW GRAND RAPIDS). *November 4, 1901.*—Grand River is navigable from its mouth at Grand Haven Harbor to Grand Rapids, a distance of 39 miles. Its natural width varies from 300 to 1,000 feet. The available depth before improvement was 1½ feet at extreme low water. The improvements (which are all located between Eastmanville and Grand Rapids) consist of training walls, the tops of which are from 1 foot to 2 feet above extreme low water, and which narrow the available width to 180 feet. The channel of best water between these training walls varies in width from 40 to 100 feet. The extreme low-water season has a duration of not more than one or two weeks in any year. The mean low water during the remainder of the year is about 1 foot above extreme low water. Channel depths given below are referred to mean low water. From Grand Haven to the mouth of Bass River (16 miles) there is an available channel over bars of 6 feet depth. From Bass

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River to Eastmanville, 5 feet; thence to Grand Rapids, 4 feet. During spring high water the river rises 16 feet at Grand Rapids.

Bridges crossing Grand River below Grand Rapids:

Lake Shore and Michigan Southern Railway bridge, situated about 2¼ miles below head of navigation at Grand Rapids: Only the right draw opening is available; it has a clear width of 54 feet. The clear height of the lowest part of the superstructure above low water is 17 feet, and above high water, 4 feet. There are two white lights 23 feet above low water (one on each end of the draw) supported by brackets which project 2 feet beyond the bridge and narrow the channel by that amount when the draw is open. The lights are not visible from the channel below the bridge when the draw is closed.

Grand Haven-Spring Lake highway bridge, situated just above the entrance to Spring Lake and 1¼ miles above Grand Haven: Both draw channels are available. The clear opening in the north draw is 60 feet, and in the south draw 62 feet. The height of the lowest part of the superstructure above mean level is 5.4 feet; the high water reference is + 2.3 feet. There are two compound red and green lights maintained, one at each end of the draw. Their height above the water is 15 feet.

Detroit, Grand Haven and Milwaukee Railway bridge, situated about 1,000 feet west of entrance to Spring Lake and 1¼ miles above Grand Haven steamboat dock: Both draw channels are available. The clear opening in the north draw is 66 feet; in the south draw, 67¼ feet. The clear height of the lowest part of the draw above low water is 5¼ feet. Two compound red and green lights are maintained, one at each end of the draw, 16 feet above the water.

Charts: Coast Chart No. 7, Lake Michigan; South End of Lake Michigan; Lake Michigan.

GRAND TRAVERSE BAY, MICH. Northport Bay on the west shore affords shelter from all except southeasterly winds. Dougherty Harbor, on the west shore, and Old Mission Harbor, on the west shore of the East Arm, afford good shelter against all winds from east through north to southwest. Sutton Bay, on the west shore, is sheltered except against northeasterly winds, and Bowers Harbor, on the east shore of the West Arm, against all except southwesterly winds.

Charts: Grand and Little Traverse Bays; North End of Lake Michigan; Lake Michigan.

GREEN BAY, MICH. AND WIS. Length, 100 miles; partly separated from Lake Michigan on the east by a peninsula approximately 75 miles long, with an average width of 10 or 12 miles. The outlet of Green Bay is approximately 30 miles wide, but the waterway is choked by several islands and submerged reefs and shoals, the channels through which have been regarded by mariners as exceedingly dangerous, though the main channel, to the northward of Washington Island, is 2 miles wide between the 10-fathom curves, and is free from obstructions. On the south side of the entrance, through the passage known as "Death's Door," many disasters have occurred owing to the strong and irregular currents which exist there.

Charts: North End of Green Bay; South End of Green Bay; North End of Lake Michigan; Lake Michigan.

GREEN BAY HARBOR, WIS. Fox River below Depere, a section about 6½ miles in length, constitutes the harbor of Green Bay; about 1 mile below Green Bay city the river discharges into the head or southern end of Green Bay, an arm of Lake Michigan.

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In its natural condition, direct entrance to the harbor was blocked by Grassy Island, situated about 1¼ miles from the mouth of the river, and the channel then existing was narrow and tortuous with an available depth of about 10 feet.

The work of improvement was begun by the United States in 1866 under a plan which provided for cutting a channel through Grassy Island and protecting the sides of the cut. The project now in force provides for the maintenance of existing works, consisting of a dredged channel in the river below Depere, continuing from the mouth of the river through Grassy Island and Sable Point Bar to the 17-foot contour in Green Bay, with revetments at Grassy Island. The dredged channel in the river below Depere is about 3 miles long, 17 feet deep, and 150 feet wide; it was completed to the required dimensions in November, 1899. The length of the channel extending from the mouth of Fox River into Green Bay is about 16,500 feet, depth 17 feet, and varying in width as follows: From the mouth of the river to north side of Grassy Island, a distance of 7,800 feet, 200 feet wide; thence 5,800 feet to Sable Point Bar, 220 feet; thence through Sable Point Bar, 2,900 feet, gradually widening to 500 feet. It was completed in 1897. The character of the improved channel is stable, but occasional dredging is necessary to maintain the required depth.

The east revetment at Grassy Island is 705 feet long, and the west revetment 620 feet long with a uniform width between them of 220 feet.

There are no special dangers or difficulties attending the navigation of either of the channels; both are well defined by buoys, and the latter is also provided with a light at its outer end and two lights at Grassy Island.

February 14, 1901.—The maximum draft that could be carried at the stage represented on the charts was 17 feet. The actual stage on the date specified was 1.7 feet lower.

Bridges crossing Fox River below Depere.

Locality and name of bridge.	Kind.	Height.*	Draw opening in the clear.		Remarks.
			Right.†	Left.†	
FOX RIVER.					
		Feet.	*Feet.*	*Feet.*	
Kewaunee, Green Bay and Western and Chicago and Northwestern railways (Eastman avenue).	Railway	7.0	90.00	90.00	One red light on each side of protection piling of center pier; three lights on top of center of bridge show red up and down stream when bridge is closed, and green when bridge is open.
Main street	Highway	5.4	65.00	64.50	Three lights on top of center of bridge show red when bridge is closed and green when bridge is open.
Walnut street	do	7.0	68.00	70.00	Do.
Mason street	do	4.0	68.00	70.00	Do.
Chicago, Milwaukee and St. Paul Railway (Porlier street).	Railway	6.5	75.00	75.00	Do.
EAST RIVER.					
Chicago, Milwaukee and St. Paul Railway (Elm street).	do	5.0	60.00	60.30	Two lights on top of bridge show red up and down stream when bridge is closed and green when bridge is open. Right opening not accessible; seldom opened.
Monroe avenue	Highway	7.5	60.125	60.125	One light on top of center of bridge shows red up and down stream when bridge is closed, and green when bridge is open. Right draw not accessible; seldom opened.
Main street	do	5.0	40.00	40.00	Not lighted; seldom opened. Left draw not accessible.
Mason street	do	5.0	40.00	40.00	The same as next above.

* Lowest part of superstructure above the stage of water represented on the charts.
† Looking downstream toward the bay.

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Harbor Rules and Regulations.

SECTION 9. All vessels, steamboats, propellers, tugs, or other crafts when passing any bridges of the city of Green Bay shall be moved past as expeditiously as is consistent with a proper movement in the river, but in no case shall any vessel, steamboat, propeller, tug, or other craft while passing any bridge, and obstructing the same, remain or obstruct the passage across such bridge more than five minutes, and no vessel, propeller, or other craft shall be so anchored or fastened as to prevent any bridge from a free and speedy opening, and the free passage of other crafts through the same. Any master or other person having charge of such vessel, propeller, or other craft who shall violate any provision of this section shall be liable to a fine of not less than five nor more than fifty dollars.

SEC. 10. Whenever any person having charge of any vessel, propeller, tug, or other craft shall wish to move the same past any bridge reasonable time shall be allowed for the opening of the same; and any person who shall move any vessel, propeller, tug or other craft against any bridge or the draw thereof before the same shall be opened to the injury thereof shall be subject to a penalty of not less than five nor more than fifty dollars, and shall also be liable to the city of Green Bay for all damages done to the bridges.

SEC. 11. No sail vessel shall pass through the draw of any bridge of this city, except it be towed by steam crafts, or under very light sail, under a penalty of five dollars.

SEC. 12. There shall be kept and maintained at or near the center of the draws on each of said bridges a bell, and it shall be the duty of the several bridge tenders immediately before opening the bridges or either of them for the passage of any vessel, steam or other craft, or for any other purpose whatsoever to ring such bell. * * *

The local tug men have adopted a system of signals for the different bridges as follows:

For bridges over Fox River, Main street, two short whistles, one long; Walnut street, one long, two short; Mason street, one long, one short, one long.

Railroad bridges and East River bridges, three long blasts.

Charts: South End of Green Bay; North End of Lake Michigan; Lake Michigan.

GREEN BAY TO THE MISSISSIPPI RIVER BY WAY OF THE FOX AND WISCONSIN RIVERS. *See* Fox River, Wis.

HARBOR SPRINGS, MICH. (ON NORTH SHORE OF LITTLE TRAVERSE BAY). A small but fine harbor of refuge, affording security in any weather. On north shore of Little Traverse Bay, docks extend to 15 feet of water.

Charts: Grand and Little Traverse Bays; North End of Lake Michigan; Lake Michigan.

HIKA, WIS. *See* Centerville.

HOLLAND (BLACK LAKE), MICH. On the east shore of Lake Michigan, about 20 miles southerly of Grand Haven. This harbor consists of Black Lake and the channel leading to Lake Michigan. Before improvement the depth was about 5½ feet in a narrow channel, obstructed by more or less unstable bars.

The present approved project provides for a 16-foot channel protected by piers and revetments to be 148 to 250 feet apart. The existing piers are insufficient in length so that the natural depth at entrance is only 7 to 8 feet and constant dredging is required for maintenance. The total length of the north pier and revetment is 1,854 feet; the easterly portion, 590 feet long, is unserviceable and 56 feet of the inner end of the north revetment is occupied by the Pere Marquette Railroad Company. The total length of the south pier and revetment is 1,691 feet. In 1874 a shore return or wing was built at the inner end of the south revetment 310 feet in length measured from the rear face of the revetment. No work has since been done upon it, with the exception of small repairs made by the occupants of the land in the rear, and it is not now proposed to

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maintain it at the expense of the Government. At present it is a complete wreck, consisting of nothing but the piles of the two side walls, and everything above water has decayed and fallen to pieces. The north pier projects 520 feet, and the south pier 685 feet, beyond the shore line. The width between the piers at the entrance is 213 feet, diminishing to 148 feet inside.

The channel is 1,850 feet long, with an angle about midway between the two lakes; it extends from Lake Michigan about S. 87° E. for 1,250 feet, and thence about S. 67° 45′ E. 600 feet to Black Lake; its depth is rendered uncertain by causes previously mentioned. At the angle the best water is usually near the north pier, and at the Black Lake end, midway between the piers. Soundings of April 18–21, 1902, showed a depth of 14.5 feet in the channel of best water across the outer bar, and a channel 12.9 feet deep for a width of 40 feet next to north pier, 200 feet inside of the outer end. At shore line the depth was 13.8 feet, and from a short distance above the shore line, to Black Lake, there was a narrow, but somewhat crooked, channel with a depth of 15 feet. The stage of the lake at the time of the soundings varied from 1.4 to 1.9 feet below mean level.

Black Lake extends about 5 miles to the city of Holland at its head. It has a width of from 1,000 to 3,000 feet. The depth in this lake is about 4 fathoms, decreasing at the upper end to 10 feet and less.

In Black Lake the mooring facilities are poor, but the anchorage is relatively good. There are no bridges and no harbor regulations are in force.

Charts: Coast Chart No. 7, Lake Michigan; South End of Lake Michigan; Lake Michigan.

KALAMAZOO RIVER, MICH. *See* Saugatuck.

KENOSHA HARBOR, WIS. On the west shore of Lake Michigan, at the mouth of Pike Creek. The sand hill upon which the lighthouse is situated, about 400 feet from the north pier, has an elevation of about 25 feet above the lake, with a broad low sand beach sloping to the lake shore. On the south side of the entrance the land is much lower, and warehouses and factories are prominent features near the shore line. Originally the point of discharge of the river was variable, and the depth varied from about 2 feet to zero. What is now termed the "Basin" is the southerly section of a bayou that extended some distance to the northward, nearly parallel to the lake shore.

The work of improvement was commenced by the United States in September, 1844, under a plan providing for the construction of two parallel piers at the southern outlet of Pike Creek. Subsequent plans provided for extending and rebuilding the piers, removing and rebuilding the north pier, widening the channel between the piers and dredging in the channel and "Basin," and the construction of a breakwater.

The project recently completed provided for extending the south pier 500 feet, removing and rebuilding the north pier from shore to the 21-foot contour to obtain a width at entrance of 250 feet, building 600 feet of breakwater, increasing the depth in channel and basin to 21 feet and 20 feet, respectively, and widening the channel between the piers. The extent of improvement in progress is the maintenance of existing works. The breakwater extends in a northwest and southeast direction. It is 600 feet long and situated 560 feet from the north pierhead and 500 feet from the south pierhead. It was not designed to and does not afford anchorage ground for vessels, or facilities for vessels to moor to, its object being to protect the harbor from the injurious effect of northeast seas.

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The north pier is 1,075 feet long, the south pier 1,865 feet long, and they project beyond the shore line 1,070 feet and 1,675 feet, respectively. The clear width between them at the entrance is 250, and at the narrowest part 230 feet.

June 28, 1901.—The channel was about 3,000 feet long, 21 feet deep; width at entrance 195 feet, and least width 170 feet. The depth given refers to stage of water represented on the charts. The actual stage on the date specified was 0.7 foot *lower*.

The channel is easily and safely navigated.

Connecting with the Government improvement the city authorities have improved the river by dredging from time to time. For a distance of 2,500 feet the channel has a navigable depth of about 11 feet.

The basin is 570 feet long; average width, 470 feet; depth, 20 feet; width at entrance from the lake, 450 feet; from the river, 112 feet. Vessels can moor to docks on the west and south sides, but should not remain during the prevalence of severe northeasterly gales, which cause violent disturbance in the basin.

Bridges across Pike Creek.

Locality and name of bridge.	Kind.	Height.*	Draw opening in the clear.		Remarks.
			Right.†	Left.†	
		Feet.	*Feet.*	*Feet.*	
Main street	Highway	13	45	64	Now being built; to be completed in May, 1902. Right draw will not be accessible. Two lights show red up and down stream when bridge is closed. The data given refers to new bridge.
Grand avenue	do	8	53	53	Head of navigation; not lighted. Draws have never been open.

*Above stage of water represented on the charts. † Looking downstream toward the lake.

Harbor Rules and Regulations.

SECTION 2. The harbormaster is hereby authorized and required to give such orders and directions relative to the location, change of place or station, manner of moving in or use of the harbor of every vessel, craft, or float, lying, moving, or laid up in the harbor within the city of Kenosha, as may be necessary to promote good order therein and the safety and equal convenience of such vessels, crafts, or floats; and any owner, master, or other person having charge of the same who shall refuse or neglect to obey any such order or direction shall be punished by a fine of not less than five nor more than twenty-five dollars and the costs of prosecution, or by imprisonment in the county jail not less than five nor more than thirty days.

That the bridge over the river connecting North Main street with South Main street in said city shall not be opened or removed from its proper place on and along said street so as to prevent or obstruct the passing and repassing of all persons and proper vehicles and conveyances over the same during the following hours, to wit, from 6.45 during and until 7.15 o'clock in the morning, and from 12 o'clock at noon during and until 1 o'clock p. m. during each and every day of each and every week except the first day of each week, commonly called Sunday.

Charts: Coast Chart No. 3, Lake Michigan; South End of Lake Michigan; Lake Michigan.

KEWAUNEE HARBOR, WIS. The immediate vicinity of the mouth of Kewaunee River is flanked by broad areas of swampy lands. In 1880 the river flowed about due south toward Kewaunee, made a sharp bend at the junction of Harrison and Main streets and flowed northward parallel to the lake shore and about 300 feet therefrom, for a distance of about 2,000 feet to the mouth, which was about 25 feet wide and had a depth of about 2 feet. A cut into the lake was made through the narrow peninsula at the bend of the river at Harrison and Main

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streets, and this cut, with the protecting piers, forms the present harbor entrance. The old natural mouth of the river is closed, and the part of the old river bed which led northward to the old river mouth is now a portion of the inner harbor.

The present project provides for the maintenance of channel and piers. The north pier is 1,900 feet, the south pier 1,850 feet long; they project beyond the shore line 1,840 feet and 1,570 feet, respectively. Clear width between them at entrance, 200 feet, at the narrowest part, 192 feet. The extent of the improvement in progress is the maintenance of existing works. The channel is of a stable character. Dredging is necessary from time to time to maintain the required depth.

April 15, 1902.—The channel is about 2,300 feet long; width at entrance, 200 feet, and least width, 75 feet, for a depth of 15 feet, at stage of water represented on the charts. The actual stage on date specified was 1.8 feet *lower*. It is easily and safely navigated.

The original outlet of Kewaunee River now forms the basin north of the present entrance. According to soundings taken April 15, 1902, it has a minimum width of about 150 feet between shore lines for a distance of about 1,200 feet up to the vicinity of the United States dock and warehouse, with a depth of about 11 feet. The stage of water on the date specified was 1.8 feet below mean lake level.

A temporary bridge crosses the basin about 800 feet from the southern end; the clear width of opening is 46 feet.

Connecting with the Government channel the Kewaunee River has a navigable depth of about 10 feet for a distance of 4½ miles, and for a distance of 2 miles farther the minimum depth is 4 feet. There is no regular commerce on the river.

Bridges crossing the Kewaunee River.

Locality and name of bridge.	Kind.	Height.*	Draw opening in the clear.			Remarks.
			Right.†	Left.†	Center.	
		Feet.	*Feet.*	*Feet.*	*Feet.*	
Miller street	Highway	7.0			45	Seldom opened; not lighted for navigation purposes, being practically above the head of navigation.
Kewaunee, Green Bay and Western Railway.	Railway	2.6	30	30		About 2 miles from mouth of river; seldom opened.

* Lowest part of superstructure above the water surface corresponding with the water surface represented on the charts.

† Looking downstream toward the lake.

There are no published harbor regulations or rules. Under date of August 30, 1901, the mayor of Kewaunee stated that when required to open the draw the city conformed to the usages known to all vessel men.

Charts: Coast Chart No. 1, Lake Michigan; North End of Lake Michigan; Lake Michigan.

KINNICKINNIC RIVER, WIS. *See* Milwaukee.

LELAND, MICH. (ON SOUTHWEST PORTION OF LEELANAW POINT, EAST SHORE OF LAKE MICHIGAN). Citizens have built a bridge pier on piles at which vessels can lie in calm weather. Carp River is so inconsiderable a stream as to preclude any use for purposes of navigation.

Charts: Grand and Little Traverse Bays; North End of Lake Michigan; Lake Michigan.

LITTLE TRAVERSE BAY, MICH. *See* Harbor Springs and Petoskey, Mich.

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LUDINGTON, MICH. On the east shore of Lake Michigan, about 8 miles south of the light at Big Point Sable. The principal western terminus of the Pere Marquette Railroad and an eastern terminus of the trans-lake car ferry, package freight, and passenger steamboat lines belonging to that company, having their western termini at Manitowoc and Milwaukee. The harbor is situated on Pere Marquette Lake, which is connected with Lake Michigan by a channel about 2,400 feet long, protected by piers and revetments for almost the entire length. Before improvement the depth varied from 7 to 8 feet and the channel was unstable. The present project provides for a channel 18 feet deep protected by piers and revetments. There are two piers; the north pier and revetment have a total length of 1,452 feet, and the south pier and revetment 2,381 feet. For a length of about 590 feet near Pere Marquette Lake the north bank is unprotected, the old slab revetment having been washed away. Five hundred and sixty-seven feet of the inner end of the south revetment is in a ruined condition. The north pier projects 860 feet beyond the shore line and the south pier 1,490 feet, and 380 feet beyond the end of the north pier. The width between the piers at the outer end is 251 feet, narrowing to 183 feet at the inner end of the north revetment. The channel bears approximately S. 84° 45′ E., and is 2,400 feet long and 19 feet deep, about 200 feet wide at the entrance, and not less than 60 feet wide inside, but at the outer end it is sometimes narrowed by a shoal from the north which projects south of the north pier. In a southwesterly gale great care is necessary to avoid this bar.

Pere Marquette Lake is between 9 and 10 miles long and has an average width of half a mile. It is 40 feet deep, and over. Pere Marquette River, which flows into Pere Marquette Lake, is not navigable above the lake. Anchorage and mooring facilities exist, the latter, however, being owned almost exclusively by the Pere Marquette Railroad Company. The drainage area discharging into Lake Michigan through Pere Marquette Lake and the Ludington entrance does not exceed 450 square miles. The outflowing volume between the piers is insignificant, and the current at the entrance moves indifferently in either direction, according to the relative elevation of the two lakes. There are no bridges and no harbor regulations are in force.

Charts: Coast Charts Nos. 8 and 9, Lake Michigan; South End of Lake Michigan; Lake Michigan.

MANISTEE, MICH. On the east shore of Lake Michigan, about 16 miles in a northeasterly direction from the light at Big Point Sable. The harbor is situated on Manistee Lake and on Manistee River flowing out of this lake. The mouth of the river, which forms the entrance, is protected by piers and revetments. Before improvement the depth was from 7 to 8 feet in an uncertain channel obstructed by sandy bars. The present project provides for a channel of navigable width, with a depth of 15 feet, extending from Lake Michigan to Manistee Lake, protected by piers and revetments at the entrance. There are two piers; the total length of the north pier and revetment is 2,906 feet; a length of 826 feet at the inner end is occupied by the Manistee and Northeastern Railroad and about 350 feet of this is in a bad condition. The total length of the south pier and revetment is 1,300 feet; the inner portion of 425 feet is occupied by the Canfield & Wheeler Company. The north pier projects 1,265 feet beyond the shore line and about 400 feet beyond the end of the south pier. The south pier projects 755 feet beyond the shore line. The width between the piers is 189 feet at the entrance, narrowing to 150 feet inside. The width between docks in the river above the piers is 135 feet and more. The channel is 9,300 feet long

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and is reasonably easy and unobstructed, there being a depth of 20 feet, for a width of 100 feet, next to the north pier at the outer end. Between the piers there is a central depth of about 16 feet, and in the river a central depth of 15.1 feet to Manistee Lake.

Manistee Lake is about 4 miles long, ½ mile wide, and has a depth of 35 feet. Anchoring facilities are poor. Mooring facilities are good. There are no harbor regulations.

The Big Manistee River enters Lake Manistee at its north end. In 1867 it was reported as navigable for small boats for a distance of 150 miles from its mouth, but navigation was then almost obstructed by the floating of logs to the mills.

Bridges crossing Manistee River:

Maple Street highway bridge: Clear width in each draw opening, 52 feet; the north or right draw is not available for vessels drawing over 9 feet; lighted by one red-and-white light on the center of the bridge, 42 feet above the water, and showing red on the river when the bridge is closed.

Smith Street highway bridge: North or right opening 60 feet and south or left opening 59 feet wide in the clear; lighted by one red-and-white light on the center of the bridge, 52 feet above the water, showing red on the river when the bridge is closed.

Manistee and Northeastern Railroad bridge: Each opening 58 feet wide in the clear.

Charts: Coast Chart No. 9, Lake Michigan; South End of Lake Michigan; Lake Michigan.

MANISTIQUE, MICH. Original depth, 7 feet, increased to 10 feet by private enterprise before any appropriation was made by the Government. Operations for improvement were commenced by the United States in 1880 under a project to provide a channel 150 feet in width, and about 12 feet in depth, by dredging between entrance piers constructed by private parties; the work was suspended in 1881 and has not since been resumed by the United States. *May 12, 1892.*—A channel about 100 feet wide with a depth of about 14.4 feet between the piers and about 12.5 feet on the outer bar. Dredging by private enterprise on the outer bar was in progress on this date. These soundings are reduced to the stage of water represented on the charts. The actual stage on the date specified was 1.38 feet *lower*. The lowest water of December, 1900, was 2.27 feet *lower*.

Charts: North End of Green Bay; Beaver Island Group; North End of Lake Michigan; Lake Michigan.

MANITOWOC HARBOR, WIS. Situated on the west shore of Lake Michigan at the mouth of Manitowoc River; in the immediate vicinity of the harbor the land on the north side is considerably higher than that on the south side. Originally a bar with only 3 feet of water over it obstructed the entrance, while for a short distance up the river the depth was 10 feet.

Operations for the improvement of this harbor were commenced by the United States in 1854 under a plan which provided for the construction of two approximately parallel piers, one on either side of the mouth of Manitowoc River, and extending into Lake Michigan. Subsequent plans provided for the repair and extension of piers, dredging, and the construction of a breakwater.

The present project provides for the maintenance of the piers, and a channel of navigable width between them, 20 feet deep; also for the maintenance of the breakwater. Occasional dredging is necessary to maintain the required depth.

The breakwater is 400 feet long; general direction, northwest and southeast; distance from north pierhead, 350 feet; from south pierhead, 295 feet. It was

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not designed to, and does not, afford anchorage ground for vessels, or facilities for vessels to moor, its object being to protect the harbor from the injurious effect of northeast seas.

The north pier is 1,970 feet and the south pier 2,400 feet long; they project beyond the shore line 1,630 feet and 1,930 feet, respectively; clear width between them at entrance, 265 feet, at narrowest part, 235 feet. The extent of improvement in progress is the maintenance of existing works.

June 1, 1901.—The channel was 2,400 feet long, 20 feet deep, at the stage of water represented on the charts, with a least width of 140 feet, and easily and safely navigated. The actual stage on the date specified was 1 foot *lower*. Connecting with the Government channel the city authorities have improved the river by dredging from time to time, for a distance of about 7,400 feet. The minimum navigable depth obtained during the season of 1901 was 18 feet.

Bridges crossing the Manitowoc River.

Locality and name of bridge.	Kind.	Height.*	Draw opening in the clear.			Remarks.
			Right.†	Left.†	Center.	
		Feet.	*Feet.*	*Feet.*	*Feet.*	
Eighth street	Highway	10.00	60.8	60.8		Light on top of center of bridge; shows red up and down stream when bridge is closed, and white when open.
Main street	Highway	11.00	64.0	64.0		Do.
Wisconsin Central Railway (Manitowoc Terminal Company) first crossing.	Railway	2.86			69.0	A single-leaf bascule bridge with one opening. One light on each side of longitudinal center of bridge shows red up and down stream when bridge is closed, and white when open.
Wisconsin Central Railway (Manitowoc Terminal Company) second crossing.	do	2.90	61.0	61.0		Not lighted; has never been opened; channel not dredged.
Chicago and Northwestern Railway.	do	8.00	60.8	60.8		Seldom opened; not lighted.
Wisconsin Central Railway (Manitowoc Terminal Company) third crossing.	do	8.58	45.0	45.0		Not lighted; has never been opened; channel not dredged.

* Lowest part of superstructure above the water surface corresponding with the water surface represented on the charts.

† Looking downstream toward the lake.

Harbor Rules and Regulations.

No. 66, SEC. 1. It is hereby made the duty of the harbor master and he is hereby authorized to give such orders and directions relative to the location, change of place or station, manner of moving or use of the harbor by every vessel or floating craft lying or moving or laid up in the harbor as may be necessary to promote order therein and the safety and equal convenience of all such vessels and floating crafts. Any owner, master, or other person having charge of any such vessel or floating craft who shall neglect or refuse to obey any such order or direction may be fined not exceeding twenty dollars for every such neglect or refusal.

No. 66, SEC. 2. It shall be the duty of the harbor master, whenever any vessel or craft is insecurely fastened, adrift, sunken or laid up not in use, which should be fastened, raised, removed or location changed, to notify and require the owner, agent or master to do the same without delay. Any owner, master or agent who shall neglect or refuse to comply with such order or direction shall be fined not exceeding twenty dollars, and a further fine of ten dollars for every day he shall neglect to comply with such order.

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No. 66, SEC. 3. If any vessel, craft, or float shall not be fastened, secured, raised, removed or its location changed in compliance with the direction of the harbor master, it shall be his duty to cause such vessel, craft or float to be secured, raised, removed or its location changed, employing such assistance as may be necessary for the purpose. All expenses which may be incurred in any such case shall be recoverable of the owner, master or agent having charge of such vessel, craft or float, and the same are hereby declared to be a lien on any such vessel, craft or float until the same is fully paid.

* * * * * * *

No. 66, SEC. 5. All vessels, c: afts or floats navigating the harbor when passing any bridge shall be moved expeditiously, and shall not be anchored or fastened to interfere with the opening of any bridge. No vessel shall be anchored within the harbor so as to interfere with the passage of other vessels. The master of any vessel violating the provisions of this section, on conviction, shall be fined ten dollars and costs of prosecution.

No. 198, SEC. 1. All steamboats, propellers, tugs or other craft coming in or going out of Manitowoc harbor or running on the Manitowoc River or other navigable waters in said city, shall move and be moved slowly so as not to endanger other crafts, bridges or docks along the river, and never at a greater rate of speed than at the rate of four miles per hour, under the penalty of twenty-five dollars for each and every offense, to be paid by the captain or person having charge, care, custody or control of any such vessel.

Charts: Coast Chart No. 1, Lake Michigan; South End of Lake Michigan; Lake Michigan.

MENOMINEE HARBOR, MICH. AND WIS. At the mouth of Menominee River, which is the boundary between Michigan and Wisconsin, the land in the vicinity has an elevation of but a few feet above the surface of Green Bay. Original depth about 4 feet.

The present project provides for the maintenance of the piers and the formation of a channel 20 feet deep, with a minimum width of 300 feet, extending from the 20-foot contour in Green Bay up the river for a distance of 3,145 feet from the point of beginning. The north pier is 1,269 feet and the south pier 2,713 feet long; they project beyond the shore line 1,060 feet and 2,150 feet, respectively; clear width between them at entrance, 370 feet; at narrowest part, 370 feet; at shore line, 400 feet.

The channel is completed to the dimensions called for by the existing project, and is easily and safely navigated.

The extent of improvement in progress is the maintenance of existing works. Dredging is occasionally necessary to maintain the required depth and width of channel.

August 31, 1901.—Maximum draft that could be carried at the stage of water represented on the charts was 20 feet. The actual stage on the date specified was 0.9 foot *lower*.

Charts: South End of Green Bay; North End of Lake Michigan; Lake Michigan.

MENOMINEE RIVER, MICH. AND WIS. This river is a part of the boundary between the States of Michigan and Wisconsin, and discharges into Green Bay at and through Menominee Harbor.

The improvements designated Menominee River and Menominee Harbor now practically constitute one work.

The original depth was about 4 feet. The extent of improvements in progress is the maintenance of a channel from Green Bay up the Menominee River for a distance of about 2 miles, 17 feet deep and 200 feet wide (except 2,600 linear feet at the upper end, reduced to 100 feet in width, with an additional length of 475 feet reduced to 75 feet in width), together with a turning basin of the same

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depth 600 feet long and 250 feet wide at upper end of channel. The basin is simply a local widening of the channel, not intended to afford anchorage or moorage.

The channel and basin have been dredged to the required dimensions, and the channel is stable in character, but deposits have been made in places of 1 foot or more, in the upper section of the channel and the northerly side of the basin, and occasional dredging will be necessary to maintain the required width and depth. It is easily and safely navigated.

August 31, 1901.—Connecting with the upper end of Menominee Harbor channel, the 17-foot channel was 200 feet wide for a distance of about 3,900 feet; thence 2,100 feet its minimum width was 120 feet; thence about 3,000 feet the least width was about 30 feet. The basin is 600 feet long, 250 feet wide, with a governing depth of about 17 feet. The maximum draft that could be carried at the stage of water represented on the charts was 17 feet; on the date specified the water was 0.9 foot *lower*.

Bridge.

Locality.	Kind.	Height.*	Draw opening in the clear.		Lights.
			Right.†	Left.†	
		Feet.	*Feet.*	*Feet.*	
Connects Main street, Menominee, with Ogden street, Marinette.	Highway	15.5	70	70	There is a white light at each end of the draw; on center of bridge a red light is visible up and down stream when the bridge is closed, and a white light when bridge is open.

* Lowest part of superstructure above the stage of water represented on the charts.

† Looking downstream toward the bay.

Charts: South End of Green Bay; North End of Lake Michigan; Lake Michigan.

MENOMINEE RIVER, AT MILWAUKEE, WIS. *See* Milwaukee.

MICHIGAN CITY, IND. This harbor is at the southern end of Lake Michigan, about 32 miles east of Calumet Harbor or South Chicago, and about 38 miles from the mouth of the Chicago River. It is the only lake harbor in the State of Indiana. The portion of Lake Michigan in the vicinity is fully exposed to storms from a northerly direction, the maximum unimpeded sweep from a little east of north being about 300 miles; all severe storms from the arc included between NNE. and NW. create dangerous conditions, including powerful and dangerous seas, and strong currents running across the harbor entrance from east to west. Michigan City is thus one of the harbors of greatest exposure to storms upon the lake, and an added unfavorable condition is found in the sandy nature and gentle slope of the lake bottom, depths of 12 to 15 fathoms occurring 8 to 10 miles from shore.

The lake shore in the vicinity is composed of fine sand which, in the neighborhood of Trail Creek, is piled up in large dunes. The harbor consists of an outer harbor (formed by breakwaters and piers and intended when completed to offer shelter for vessels seeking refuge from northerly storms), and the improved channel of Trail Creek, forming an inner harbor for the local commerce. The original depths before improvement were 9 feet upon the outer bar and 3½ feet or less at the entrance to the inner harbor, the obstructions being unstable

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sand bars. The channel at the proposed entrance to the outer harbor is now about 25 feet deep, while between the piers a depth of 15 feet is found. This latter depth can not be carried clear through the inner harbor, but the depth varies from 15 feet between the piers to 12 feet at the lower end of the upper basin. The present approved project provides for the completion of a new outer harbor, to be constructed by extending the breakwater, or east pier, 600 feet in a northwesterly direction and by building a new detached breakwater 1,400 feet long, to run about N. 30° E. and S. 30° W., farther out in the lake than the existing detached breakwater, the two new structures being separated by an interval of 650 feet. The existing detached breakwater is to be removed. For the inner harbor the present approved project is purely one of maintenance and is intended to create, by dredging, a channel between revetments 97 to 175 feet apart, except at the turning basins where the width is about 330 and 345 feet.

Breakwaters.—The old outer harbor, constructed under a former project, since abandoned, comprises an outer basin east of the entrance to the inner harbor and inclosed upon the east by a pile pier 1,225 feet long in an unserviceable condition, and on the north by a crib breakwater 1,411 feet long, and an area to the west of the entrance, protected by a breakwater pier now 935 feet long, connected at right angles with the old breakwater above described, and further protected by a detached breakwater 708 feet long, running about N. 71° 30′ E., and separated from the pier by an interval of 400 feet. The outer basin has never been dredged and can not be used by deep-draft vessels, and the sheltered area under the detached breakwater is too restricted for safe anchorage. Four hundred feet of the extension to the breakwater pier provided for under the new project has been built and the entire foundation of the detached breakwater is in place. The entrance width, between the present north end of the breakwater pier and the east end of the old detached breakwater, is about 280 feet. The channel which forms the inner harbor is protected at the entrance by two piers, and inside by revetments built partly by the United States and partly by local interests, and following generally the original course of Trail Creek. The outer end of the west entrance pier is opposite the southerly end of the breakwater pier, and the two form the entrance, 215 feet wide, to the inner harbor. The original length of the west entrance pier and revetment was 2,157 feet; the inner end has, however, greatly deteriorated, so that from station 0 to 2+28 nothing capable of being shown upon a map remains above water. This pier projects 1,280 feet beyond the shore line. The length of the east entrance pier and revetment is 1,405 feet. The width between the piers at the entrance is, as stated, 215 feet, and at the narrowest part, 97 feet.

The channel of the inner harbor is 9,159 feet long from the outer end of the west pier, between revetments from 97 to 175 feet apart except at the turning basins, where the width is about 330 and 345 feet. The upper limit of this improved channel is 100 feet above the upper turning basin. From the entrance, to the inner end of the piers, the ruling depth in this channel is 15 feet; thence, 14 feet to the Michigan Central Railroad bridge, and 13 feet from that point to the first bend above the Sixth Street bridge; above this latter bridge the channel is 12 feet deep to the lower end of the upper basin.

Inner Harbor Basins.—The lower basin is on the south side of the harbor. It begins 800 feet above the Michigan Central Railroad bridge and is 213 feet wide and 250 feet long from the south dock. Its depth is generally 13 feet. It is adapted for anchorage of vessels and has the necessary facilities for mooring. The upper basin is at the present upper end of the inner harbor. Its width is 345 feet and its length 400 feet. It has a depth of from 10 to 12 feet, in the lower

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portion, and about 4 feet in the upper half. The lower portion can be used for anchorage and is provided with docks for mooring vessels.

The following lights are maintained by the United States Engineer Department at the harbor entrance: Red signal lights on the east end of the detached breakwater and breakwater pier, 11 feet from the present outer end; white signal lights on the breakwater pier 672 feet from the present outer end, and on the west pier 95 feet from the outer end.

Bridges crossing the inner harbor at Michigan City:

Franklin Street bridge, 830 feet above the inner end of the east revetment: South or left draw opening, 42.5 feet clear width; north or right draw opening, 36 feet clear width (not used). Three compound lights on the bridge (one at each end, 34 feet above the water, and one in the center, 37 feet above the water, show red up and down stream when the bridge is closed, and green when the bridge is open. There are two compound red and green lights on the guard pier, 9 feet above water, one located at the west end of the pier and one in the center of the pier.

Michigan Central Railroad bridge, about 1,850 feet above the Franklin Street bridge: Clear width in each draw opening, 44 feet. A red and green light on the center of the bridge and one at each end, 42 feet above the water, show red on the channel when the bridge is closed. There are three red lights at each end of the guard pier, and two red lights under the bridge at each end.

Sixth Street bridge, 1,700 feet above the Michigan Central Railroad bridge: Clear width in each draw opening, 46 feet. Lighted by six lights (four white, and two compound red and green), all placed 17 feet above the water. There are two white lights at each end of the bridge, and the two compound lights are in the center of the bridge, one upon the upstream truss and the other upon the downstream truss. The compound lights show red up and down stream when the bridge is closed and green when the bridge is open.

Harbor Rules and Regulations.

Harbor rules and regulations have been prescribed by the local authorities and are as follows:

SECTION 1. Be it ordained by the Common Council of Michigan City: The harbor master shall give such orders and directions relative to the location, change of place or station, manner of moving, or use of the harbor, of every vessel, craft or float laying, moving or laid up in the harbor not in use, as may be necessary to promote good order therein and the safety and equal convenience of such vessels, crafts or floats, and any owner, master, or other persons having charge of the same, who shall refuse or neglect to comply with such order or direction, shall be subject to a penalty of twenty-five dollars for every such neglect or refusal, which penalty shall constitute a lien upon such vessel, craft or float until fully paid.

SEC. 2. Whenever there shall be in the harbor any vessel, craft or float insecurely fastened, adrift, sunken or laid up not in use, which may require to be fastened, raised, removed or its location changed, the harbor master shall notify the owner, master or other person, who may be in charge thereof to secure, raise or remove such vessel, craft or float without delay. But if the harbor master shall be unable to find the master, owner or person in charge of such vessel, craft or float as aforesaid, or if no person answering such description can be found by him, such notice shall not be required by him, and any person who shall neglect or refuse to comply with such order or direction shall be subject to a penalty of twenty-five dollars and the further penalty of ten dollars for every day he or they shall refuse or neglect to observe the same, which penalty shall constitute a lien upon such vessel, craft or float until fully paid.

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SEC. 3. If any vessel, craft or float shall not be secured, raised, removed, or its location changed in compliance with the direction of the harbor master after notice, or if the harbor master shall be unable to serve such notice as aforesaid in either case he shall cause such vessel, craft or float to be secured, raised, removed or its location changed as aforesaid, employing such assistance as may be necessary for the purpose. All expenses which may be incurred in any case shall be recoverable of the owner or consignee, master or other person having charge of such vessel, craft or float; and the same expenses are hereby declared to be a lien upon such vessel, craft or float until fully paid. And if any person shall resist the harbor master or any person acting under him, in the execution of such duty, or of any duty imposed upon him by this chapter, such person so resisting shall be subject to a fine of not less than ten dollars and not exceeding one hundred dollars and may be imprisoned not exceeding thirty days.

SEC. 4. All penalties, fines, damages and expenses which may be made or become a lien upon any vessel, craft or float by the provisions hereof shall attach from the time the right of action may accrue, and the harbor master shall detain any such vessel, craft or float subject to such lien or such parts of her rigging, anchors or apparel as shall be sufficient to discharge the same, such lien not otherwise discharging may be enforced against the vessel, craft or float or other property so detained by an attachment against such vessel, craft or float by her or its name or against the owner or owners thereof if known, in the manner provided by the laws of this State for the enforcement of maritime claims against boats and vessels. All suits which may be brought under this chapter whether in rem or in personam, shall be brought in the name of the City of Michigan City and all the expenses which may be incurred in such detention shall likewise be a lien upon such vessel, craft or float, and recoverable as a part of the original cause of action. All moneys which may be paid to or collected by the harbor master or which shall be collected in any suit instituted as aforesaid, shall be paid by the officer collecting the same into the City Treasury. If any person or persons shall resist the harbor master, or any person acting under him in the detention of any vessel, craft or float for the purpose aforesaid he and they shall be subject to a fine of not less than ten dollars and not exceeding one hundred dollars.

SEC. 5. No vessel, craft or float shall be so moved or anchored within the harbor, or in any slip or dock as to prevent the passage of any other vessel, craft or float, nor shall any vessel, craft or float be so moved as to run against or injure any bridge across the river under a penalty of not less than ten dollars nor exceeding one hundred dollars to the master, owner or person in charge thereof.

SEC. 6. No person discharging the cargo of any vessel, craft or float shall suffer any part of such cargo to remain projecting over the front of any wharf after such vessel, craft or float remove from the wharf, under a penalty to master, owner, or other person having charge of such vessel, craft or float, occupying such wharf of ten dollars for every hour such projection shall continue.

SEC. 7. All vessels, crafts or floats lying in or navigating the harbor shall be respectively governed by the following further provisions:

First: All vessels, crafts or floats shall be moved slowly, so as not to, in any case, injure or endanger other vessels.

Second: No master or other person owning or having charge of any vessel, craft or float, shall leave the same in the harbor without having on board, or in charge thereof, some competent person to control, manage and secure the same without first obtaining permission of the harbor master.

Third: All vessels, crafts or floats whether using steam or otherwise while in the harbor shall have and keep their anchors inboard or suspended from the hawse pipe by the ring or shackle, and said ring or shackle shall be below the surface of the water, and their lower yards cock-billed and their upper yards braced up sharp.

Fourth: They shall likewise have and keep outboard during the nighttime a conspicuous light and shall have extinguished or safely secured at dark all fires, which may be kept on board.

Fifth: No vessels, crafts or floats shall be suffered to lie in the harbor adrift or insecurely fastened.

Sixth: Any master, owner or other person having charge of any such vessel, craft or float, shall be subject to a fine of not less than twenty dollars nor

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exceeding one hundred dollars for every violation of the foregoing provisions and to like fine for every refusal to conform thereto when directed by the harbor master.

SEC. 8 All penalties, fines and damages, which may be incurred by the owner, consignee, master or other person having charge of any vessel, craft or float, under any provision of this chapter, are hereby declared to be recoverable of and a charge and lien on the vessel, craft or float of which he may be owner, consignee, master or in charge, and such lien may be enforced in the same manner as other liens against the same.

SEC. 9. No person shall cast or deposit, or suffer to be cast or deposited in the harbor or slip within the limits of the city, any earth, ashes or other heavy substances or substance, filth, logs or floating matter, or any obstructions under a fine of not more than one hundred dollars for each and every offense, and not more than twenty-five dollars for every day the same shall be suffered to remain there.

SEC. 10. The harbor master shall be appointed a special policeman for the purpose of carrying more readily into effect the police regulations of the city concerning the harbor under his charge and to preserve the public peace and quiet in and about said harbor.

SEC. 11. The words vessels, crafts and float, shall be deemed to include every species of steam and other vessels or boats lying or floating in or navigating the harbor and also all rafts or logs, timber, wood, lumber, or other floating matter and the harbor shall be deemed to include Trail Creek to the City limits and the piers and so much of Lake Michigan as lies within the distance of one mile of the shores of the City.

Charts: Coast Chart No. 5, Lake Michigan; South End of Lake Michigan; Lake Michigan.

MILWAUKEE BAY, WIS., HARBOR OF REFUGE AT. The general direction of the shore arm of the breakwater for a distance of 2,450 feet is S. 25° E.; the main arm then runs S. 11° W. for 5,200 feet; 1,000 feet south from the angle there is an opening 400 feet wide for a fair-weather entrance and exit; total length of breakwater, 7,250 feet. The distance of the southerly end from the mouth of Milwaukee Harbor is 4,200 feet. The protected area available for the use of vessels is about 270 acres beyond the 16-foot contour, and the maximum depth 33 feet at *standard low water*. The anchorage ground is good. No provision is made for mooring vessels to the breakwater, and such mooring is prohibited, except in the case of harbor tugs.

Charts: Milwaukee Harbor; Coast Chart No. 3, Lake Michigan; South End of Lake Michigan; Lake Michigan.

MILWAUKEE HARBOR, WIS. The natural mouth of Milwaukee River had a depth of about 3.5 feet, and was about 3,000 feet southerly of the present artificial outlet; the latter was formed by the construction of piers, and dredging between them and through the low and narrow neck of land that separated the river and the lake at this point. The present channel is of a stable character, but occasional dredging is necessary to maintain the required depth.

The present project provides for the formation and maintenance of the piers and channel between them, 200 feet wide and 18 feet deep at *standard low water*.

The north pier 1,653 feet and the south pier 1,637 feet in length, project 1,620 feet and 1,500 feet, respectively, beyond the shore line; clear width between them at entrance 280 feet, at narrowest part 260 feet.

The extent of the improvement in progress is the maintenance of existing works.

Connecting with the Government channel the city authorities have improved the rivers by dredging from time to time. The channels are easily and safely navigated.

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Bridges across the Milwaukee, Menominee, and Kinnickinnic rivers at Milwaukee, Wis.

No.	Locality and name of bridge.	Kind.	Height.*	Draw opening in the clear.			Remarks, lights.
				Right.†	Center.	Left.†	
	MILWAUKEE RIVER.		*Feet.*	*Feet.*	*Feet.*	*Feet.*	
1	Chicago and Northwestern Railway (Jefferson street).	Railway	6.28	87.00		86.10	One stationary red light on each end of center of protection pier shows red up and down stream when bridge is closed, and when it is open; one red light on top of center of draw span of bridge is visible to navigators when bridge is closed, but is invisible to them when bridge is open.
2	Broadway	Highway	20.30		100.00		Bascule bridge in process of construction; to be completed in September, 1902.
3	East Water street	do	19.60	67.50		69.50	One light on each end of bridge in the longitudinal center thereof shows red up and down stream when bridge is closed, and white when bridge is open.
4	Buffalo street	do	18.80	75.00		74.50	Do.
5	Huron street	do	15.80		78.00		Bascule bridge. One red light on each side of and near outer end of each leaf just underneath the roadway, showing up and down stream two red lights close together when bridge is closed, and when open two red lights 60 feet or more apart.
6	Michigan street	do	14.80	65.00		65.00	Lights the same as (No. 3) East Water Street bridge, described above.
7	Grand avenue	do	14.30		70.00		Bascule bridge. Lights the same as (No. 5) Huron Street bridge, described above.
8	Oneida street	do	14.30	67.25		67.25	Lights same as (No. 3) East Water Street bridge, described above.
9	State street	do	14.70	60.50		58.50	Do.
10	Chestnut street	do	14.30	65.50		63.50	Do.
11	Cherry street	do	13.60	55.00		55.00	Do.
12	Walnut street	do	12.80	57.50		57.50	Do.
13	Holton street (viaduct)	do	53.30		60.00		Bascule bridge. Lights same as (No. 5) Huron Street bridge, described above.
14	Racine street	do	27.30				Practically at head of navigation. Fixed bridge. One light on each end of bridge, showing red up and down stream.
	MENOMINEE RIVER AND CANALS.						
15	Chicago, Milwaukee and St. Paul Railway (West Water street).	Railway	8.80	52.00		59.00	One light on top of center of bridge shows red up and down stream when bridge is closed.
16	West Water street	Highway	12.20	52.00		52.00	The same as (No. 3) East Water Street bridge, above.
17	Sixth street	do	23.30	53.00		52.00	Do.
18	First avenue	do	15.10	50.00		50.00	The same as (No. 3) East Water Street bridge above. Across artificial channel called Menominee Canal.
19	Muskego avenue	do	12.00	51.00		50.00	The same as (No. 3) East Water Street bridge above.
20	Chicago, Milwaukee and St. Paul Railway (Florida street).	Railway	9.70	47.00		49.00	Across artificial channel called Burnham's Canal. One light on each end of bridge, showing red up and down stream when bridge is closed, and white when open.

* Lowest part of superstructure above the water surface, represents the new plane of "standard low water."
† Looking downstream toward the lake.

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Bridge across the Milwaukee, Menominee, and Kinnickinnic rivers at Milwaukee, Wis.—Continued.

No.	Locality and name of bridge.	Kind.	Height.*	Draw opening in the clear.			Remarks, lights.
				Right.†	Center.	Left.†	
21	Sixth avenue	Highway	11.00	45.00		46.00	The same as (No. 20) just above.
22	Sixteenth street	do	35.00		66.00		The same as (No. 5) Huron Street bridge described above. Bascule bridge.
	KINNICKINNIC RIVER.						
23	Chicago and Northwestern Railway (foot of Lapham street).	Railway	9.30	55.00		55.00	One light on each end and each side of center protection pier; also one on each abutment underneath roadway. One on center of draw span and one near each end of the same; all show red up and down stream when bridge is closed, and when open, except the one in the center of draw span—that is then shielded from the view of navigators.
24	Kinnickinnic avenue	Highway	13.00	37.5		53.00	One light on each end of bridge showing red up and down stream when bridge is closed and white when open.
25	Chicago, Milwaukee, and St. Paul Railway (Ziemer street).	Railway	10.3	61.00		60.50	One red light is shown when bridge is open; at all other times no light is shown.
26	Chicago and Northwestern Railway (between Kinnickinnic avenue and Clinton street).	do	12.3	70.25		71.25	One red light on top of center of drawspan showing red up and down stream when bridge is closed; when the bridge is open no light is visible from vessels.
27	Clinton street	Highway	13.1	62.00		62.00	One light on each end of bridge showing red up and down stream when bridge is closed, and white when open.
28	Becher street	do	12.00	54.00		54.00	Do.
29	Lincoln avenue	do	9.3	54.00		54.00	One light on each end of bridge showing red up and down stream when bridge is closed, and white when open. Left draw not accessible.

* Lowest part of superstructure above the water surface, represents the new plane of "standard low water."
† Looking downstream toward the lake.

General Ordinances of the City of Milwaukee, relating to Harbor and Rivers.

SECTION 1. The harbor master is hereby authorized and directed to give such orders and directions as he shall deem just and proper, relative to the location and change of station of every steamboat, vessel, propeller, tug, or other craft or float in the harbor, river, or other navigable waters in the city of Milwaukee, and every captain, master, owner, assignee, or person having in charge any steamboat, propeller, vessel, tug, craft, or float, who shall neglect or refuse to comply with any such orders or directions, shall forfeit a penalty of not less than five nor exceeding twenty-five dollars.

SEC. 2. All steamboats, propellers, tugs, or other craft coming in or going out of the harbor or running on the Milwaukee, Menominee, or Kinnickinnic rivers or other navigable waters in said city, shall move and be moved slowly so as not to endanger other crafts or bridges; and all steamboats, vessels, propellers, tugs, and other crafts or floats shall have kept on board during the nighttime a light in a conspicuous place; any captain, owner, mate, or other person having charge or control of any craft described in this section who shall violate any provision

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of this section shall forfeit and pay for each offense a penalty of not less than five nor exceeding twenty-five dollars.

SEC. 3. Any owner, master, or other person having in charge any steamboat, vessel, or other craft or float who shall anchor or otherwise fasten or permit to be anchored or fastened any steamboat, vessel, propeller, tug, or other craft in the harbor, rivers, or other navigable waters within the limits of the city of Milwaukee, so that the same shall obstruct the passage of any other steamboat, vessel, propeller, tug, or other crafts coming in or going out of said harbor or rivers or other navigable waters, shall forfeit a penalty of not less than five nor more than twenty-five dollars for each and every offense.

SEC. 4. All vessels, steamboats, propellers, tugs, or other crafts navigating the Milwaukee, Menominee, Kinnickinnic rivers or other navigable waters within the limits of the city of Milwaukee, when passing any bridge in the city of Milwaukee, shall move and be moved past the same as expeditiously as is consistent with a proper movement in the river, but in no case shall any vessel, steamboat, propeller, tug, or other craft, while passing any bridge and obstructing the same, remain or obstruct the passage across such bridge more than five minutes, and no vessel, propeller, or other craft shall be so anchored or fastened as to prevent any bridge from a free and speedy opening; any master or other person having charge of such vessel, propeller, or other craft who shall violate any provision of this section shall be liable to a fine of not less than five dollars nor more than twenty-five dollars.

SEC. 5. Whenever any person having charge of any vessel, propeller, tug, or other craft shall wish to move the same past any bridge reasonable time shall be allowed for the opening of the same, and any person who shall move any vessel, propeller, tug, or other craft against any bridge or the center or protection pier thereof, before the same shall be opened, to the injury thereof, shall be subject to a penalty of not less than five nor more than fifty dollars, and shall be likewise liable to the city of Milwaukee for all damages done to the bridge and center or protection piers thereof.

SEC. 6. No sail vessel shall pass through the draw of any bridge in the city of Milwaukee, except it be towed by steam crafts, under a penalty of five dollars and costs of prosecution.

SEC. 7. No person shall cast or deposit or suffer to be cast or deposited in the harbor of the Milwaukee, Menominee, or Kinnickinnic rivers, or any other navigable waters within the limits of the city of Milwaukee, any earth, sand, filth, manure, or any obstruction, under a penalty of not less than five nor more than fifty dollars with costs of prosecution.

SEC. 8. No vessel or craft propelled by steam shall pass up or down the Milwaukee, Menominee, or Kinnickinnic rivers, or any other navigable waters within the limits of the city of Milwaukee, at a greater rate of speed than at the rate of four miles per hour, under the penalty of twenty-five dollars for each and every offense, to be paid by the captain or the person having the charge, care, custody, or control of any such vessel.

SEC. 9. No vessel shall be towed in the Milwaukee, Menominee, or Kinnickinnic rivers, or any other navigable waters within the limits of the city of Milwaukee, by any tug or vessel while the anchor or anchors of such vessel so towed are down or dragging on the bottom of such rivers, under a penalty of not less than one hundred nor more than five hundred dollars, to be paid by the captain or other person having charge, care, custody, or control of such tug or steam-propelled vessel, or of such vessel so towed, any, either or both of them.

SEC. 10. Any master or owner, or other persons having in charge any steamboat, vessel, or other craft or float, who shall run the same carelessly, willfully, or negligently into the piers, cribs, or docks of the harbor, at the Straight-cut, or into any bridge or abutment thereof, or allow such steamboat, vessel, or other craft or float to be driven or run into such piers, cribs, docks, bridge, or abutment, or who shall take any stones from the crib for ballast or any other purpose, shall forfeit for the use of the city of Milwaukee the penalty of five hundred dollars for every such offense, and every such steamboat, vessel, or other craft or float, of which the owner, master, or other person having charge of the same shall become liable, as aforesaid, shall also be chargeable with such forfeiture or penalty, and also for all damage done thereby to the piers, cribs, or docks, and shall forfeit and pay to the city of Milwaukee the full cost of replacing all damage done and the cost of replacing all stones and timbers taken away or removed from their proper places.

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SEC. 11. All steamboats, propellers, tugs, boats, or vessels, while navigating, lying or being within that part of Milwaukee Bay which is within the limits of the city of Milwaukee, or while navigating, lying or being within any of the rivers or navigable waters within the limits of said city, are hereby prohibited from blowing any steam whistle, for any purpose whatever, except that when it shall be necessary for them to pass through any bridge within the limits of the said city, other than the bridge across the Menominee River, at the foot of West Water Street, the railroad bridge located about one-half block east of the last-mentioned bridge, the railroad bridge of the Chicago & Northwestern Railroad across the Kinnickinnic River, between Kinnickinnic Avenue and Clinton Street and Point Street bridge and Kinnickinnic Avenue bridge, they may give three short blasts of the whistle, each blast not to exceed two seconds in length, as a signal for such bridge to open, and as a signal for opening the above-mentioned bridge across the Menominee River, and the said two railroad bridges and said Kinnickinnic Avenue bridge they may give four short blasts of the whistle, each blast not to exceed two seconds in length, and as a signal for opening Point Street bridge they may give two short blasts of the whistle, each blast not to exceed two seconds in length; provided, however, that no tug, propeller, or steamboat shall sound her whistle while occupying the draw of any bridge in this city or within one hundred feet thereof, unless the same shall be blown by a steamer, propeller, or tug lying at a dock, as the signal for the opening of the next nearest bridge; and for each violation of this section a penalty of not less than twenty dollars, nor exceeding one hundred dollars, is hereby imposed, which penalty may be collected from the person blowing such whistle, or causing the same to be blown, or of the master, owner, or owners of such steamboat, propeller, tug, boat, or vessel.

SEC. 12. Every steamboat, vessel, or other craft, when passing in the draw of the bridge across the Menominee River, from West Water Street, in the city of Milwaukee, shall pass through bow first. Every captain or other persons in charge of any steamboat, vessel, or other craft violating the provisions of this section shall, upon conviction thereof, be fined not less than ten nor more than fifty dollars for each offense.

SEC. 13. It shall be unlawful for any person or persons to sell or expose for sale, or deliver, from any ship or vessel, landed at the foot of any street or alley, in the city of Milwaukee, any wood, lumber, coal, staves, or any other goods, wares, or merchandise, or to tie up or moor any vessel or craft at the foot of any street or alley in the city of Milwaukee—except that stone, wood, lumber, and other materials and articles, which are or may be delivered for the city of Milwaukee, or any ward thereof, and bought by the city of Milwaukee, for the use of said city, or any department or ward thereof, may be so delivered if agreed upon at the time of the making of the contract thereof. It shall also be unlawful to fasten any craft or vessel of any description to protection piers of bridges, bridge appr aches, or piles driven for the protection of bridge piers or approaches in the city of Milwaukee. Any person or persons violating the provisions of this section shall be fined not less than ten nor more than fifty dollars for each offense.

Charts: Milwaukee Harbor; Coast Chart No. 3, Lake Michigan; South End of Lake Michigan; Lake Michigan.

MUSKEGON, MICH. On the east shore of Lake Michigan, nearly 12 miles NNW. of the harbor of Grand Haven. Before emptying into Lake Michigan, Muskegon River, one of the largest in Michigan, expands into Muskegon Lake. The river below Muskegon Lake and the lake itself form the harbor of Muskegon. Improvements have been confined to the channel between Lake Michigan and Muskegon Lake, which channel, when operations were begun by the United States, was 3,000 feet long and about 12 feet deep except at the entrance, where the depth was 11 feet and the channel line uncertain, the obstructions consisting of bars composed of the light sand common in this locality.

The present project provides for a through channel 15 feet deep, 300 feet wide at the entrance and 180 feet wide at the shore line, protected by suitable piers and revetments. There are two piers. The total length of the north pier and

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revetment is 2,780 feet, and of the south pier and revetment, 2,090 feet. A considerable portion of the north revetment is in bad condition. The north pier projects 1,380 feet beyond the shore line, and the south pier 1,510 feet beyond the shore line and about 170 feet beyond the north pier. The clear width at the entrance is 308 feet, narrowing to 182 feet near the shore line, and to 167 feet farther inside. The channel from lake to lake is about 5,200 feet long, and above the Government revetments is unprotected, except for a length of about 950 feet on the south side where the Pere Marquette Railroad maintains a wharf and slip for the trans-lake car ferries. The width of this part of the channel varies from 210 to 480 feet.

The old slab piers formerly existing have been washed away or are a complete wreck.

Soundings of April 14–16, 1902, show a central bar opposite the entrance, and about 400 feet outside of the end of the south pier, with a depth, on its shoalest point, of 17.4 feet. The southern approach to the entrance affords a depth of 21 feet, while the least depth on the line of the south pier is 19.2 feet. At the end of the south pier there is a channel 20 feet deep, for a width of 120 feet next to that pier. The northern half of the channel is occupied by a shoal with a depth of 15.2 feet on the shoalest point, 50 feet south of the line of the north pier. The depth in the channel between the piers, which generally is not less than 17 feet, is reduced to 15.5 feet by a shoal reaching across the channel near the shore line. The stage of the lake at the time of the soundings was −1.7 to −1.8 feet.

Muskegon Lake has a length of about 5 miles and width of from 1 to 2 miles, and general depths of from 30 to 40 feet, reaching a maximum of 78 feet, with 15 to 20 feet at the heads of the landing piers at the city of Muskegon. This is the only basin existing at the harbor. Anchorage is good. Wharves can be found only at the city of Muskegon. No harbor regulations are enforced.

Charts: Muskegon Harbor, including Muskegon Lake; Coast Chart No. 8, Lake Michigan; South End of Lake Michigan; Lake Michigan.

Muskegon River, Mich. Empties into Muskegon Lake, and has a length of about 33 miles to Newaygo, which may be called the head of navigation. For a distance of about 24 miles below Newaygo the average width is about 230 feet, with depths varying from 3½ to 9 feet at a stage of about 2 feet above extreme low water. Two highway bridges, one about ¼ mile and the other 14½ miles below the head of navigation, obstruct this part of the river. For the remaining 9 miles the main branch of the river varies in width from about 80 to 230 feet, averaging about 130 feet, and is from 2½ to 9 feet deep at a stage of about 2 feet above extreme low water. The Pere Marquette Railroad bridge crossing the river at Muskegon has one draw opening, 32 feet wide in the clear. The south opening of the highway drawbridge crossing the river below the railroad bridge has a clear width of 39 feet; the north opening is not accessible.

Charts: Muskegon Harbor, including Muskegon Lake; Coast Chart No. 8, Lake Michigan; South End of Lake Michigan; Lake Michigan.

New Buffalo, Mich. This harbor is formed by a deep creek, known as Galien River, passing through a marsh, which was formerly a small lake, or an arm of Lake Michigan itself. In 1868 a cut 1,400 feet long, 40 feet wide, and 6 feet deep was carried through to Lake Michigan. A pier 300 feet in length was constructed east of the entrance to this cut in 1871, and extended 100 feet in 1884. No work has been done at this harbor since that date. In 1885 there was less than 3 feet of water at the entrance.

Charts: Coast Chart No. 5, Lake Michigan; South End of Lake Michigan; Lake Michigan.

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NORTH BAR LAKE, MICH. *See* Arcadia.

NORTH FOX ISLAND, MICH. *See* Fox Islands.

NORTH MANITOU ISLAND, MICH. A lee can be found under North Manitou with generally good holding ground. The bight on the east side affords good shelter from westerly winds; depth of 14 to 20 fathoms.

Charts: Manitou Passage; Grand and Little Traverse Bays; North End of Lake Michigan; Lake Michigan.

NORTHPORT BAY, MICH. On west shore of Grand Traverse Bay, affords shelter from all except southeasterly winds. Care must be taken to avoid two dangerous shoals in the northern part of the bay, and shoal water around Bellow Island.

Charts: Grand and Little Traverse Bays; North End of Lake Michigan; Lake Michigan.

OCONTO HARBOR, WIS. On the west shore of Green Bay at the mouth of Oconto River. The city of Oconto is about 2 miles up the river; below Oconto the river traverses a belt of low swampy ground, the elevation of which is but slightly above the surface of the river. The original depth of water was about 2 feet, increased by private enterprise to about 3.5 feet. Inside the shore ends of the piers the banks of the river are unprotected by revetments, and bars form in the wide portions of the channel from scour in the narrower parts during severe freshets. The existing project provides for the formation and maintenance of a channel 100 feet wide and 9 feet deep from Green Bay to Spies' Mill, a distance of about 9,000 feet, by parallel piers and by dredging. The extent of improvement in progress is the maintenance of existing works. Dredging is occasionally necessary to maintain the required depth.

The north pier is 1,603 feet long, and the south pier 2,151 feet long; their projection beyond the shore line is 1,040 feet and 1,660 feet, respectively, in a direction about N. 54° 20′ E. There is a uniform clear width between the piers of 150 feet. The width of the improved section of the river varies from 125 feet to about 300 feet. The improved channel therein is about 7,000 feet long, with a projected width of 100 feet and depth of 9 feet.

May 14, 1900.—The maximum draft that could be carried was 9 feet at mean lake level. The actual stage on the date specified was 1.4 feet *lower*. The channel was of the required dimensions except the upper 1,200 feet of it, which was reduced to a minimum width of about 70 feet. Its navigation is not dangerous or difficult.

Charts: South End of Green Bay; North End of Lake Michigan; Lake Michigan.

OLD MISSION HARBOR, MICH. *See* Grand Traverse Bay.

PENSAUKEE, WIS. Original depth, 2 feet, increased by private enterprise to from 7 to 9 feet for a width of 30 feet. The work of improvement was commenced by the United States in 1883, under a plan providing for extending a pier, built by private enterprise, at the north side of the mouth of the Pensaukee River, and for the formation, by dredging, of a channel 100 feet wide and 10 feet deep on the south side of the pier, to connect the deep water in Green Bay with that in the river; 1,300 feet of pier extension was constructed and the channel dredged to a depth of 10 feet and width of 25 feet. Government operations were suspended in November, 1883, and, with the exception of repairs to the pier, have not since been resumed. The portion of the pier built by private

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enterprise was destroyed in October, 1885, with resulting deterioration of the channel to about its original condition.

October 24, 1895.—It is reported that dredging by private parties is in progress to secure a channel about 40 feet wide and 7 feet deep. These soundings are reduced to the stage of water represented on the charts. The actual stage on the date specified was 2.8 feet *lower*. The lowest water of December, 1900, was 2.27 feet *lower*. The formation of a channel 100 feet wide and 10 feet deep by the construction of one pier and dredging was suspended in November, 1888, and no work other than repairs to the pier has since been done.

Charts: South End of Green Bay; North End of Lake Michigan; Lake Michigan.

PENTWATER, MICH. On the east shore of Lake Michigan, about 9 miles in a northeasterly direction from Little Point Sable. The harbor of Pentwater is formed by Pentwater Lake and the channel connecting with Lake Michigan. Before improvement the depth in a narrow and uncertain channel, which was much obstructed by fluctuating sand bars, was about 4 feet. The draft which can be carried through from lake to lake is about 12 feet.

The existing project provides for a channel 150 feet wide at the entrance and 12 feet deep, protected by suitable piers and revetments. There are two piers. The total length of the north pier and revetment is 2,226 feet, extending from Pentwater Lake to Lake Michigan; 912 feet of the revetment at the inner end is in ruined condition. The total length of the south pier and revetment is 1,847 feet. From the inner end of the Government revetment to Pentwater Lake the south bank of the channel is occupied by a pile dock in ruined condition, belonging to the Pere Marquette Railroad Company. The north pier projects 660 feet beyond the shore line and 150 feet beyond the end of the south pier, which projects 595 feet beyond the shore line. The clear width between the piers at the entrance is 153 feet, narrowing to 140 feet at the inner end. The channel from lake to lake is about 2,226 feet long and has a width that varies from 140 to 153 feet; it bears about S. 68° E. Its natural depth is from 9 to 10 feet, increased by periodical dredging to about 12 feet. At the entrance the best water is generally near the north pier.

Pentwater Lake is about 2½ miles long and ¼ mile wide, and has a depth of 25 feet and over. This is the only basin. Anchorage in the lake is good, but no wharves exist. There are no bridges and no harbor regulations are enforced.

Charts: Coast Chart No. 8, Lake Michigan; South End of Lake Michigan; Lake Michigan.

PERE MARQUETTE LAKE, MICH. *See* Ludington.

PETOSKEY, MICH. On the south shore of Little Traverse Bay, near its inner end. The harbor facilities consist of a private wharf projecting about 650 feet beyond the shore line and protected on the north and west by two detached breakwaters built to shelter this wharf from westerly storms. The available depth at the outer end of the wharf is about 15 feet. The north breakwater, at present 200 feet long, runs parallel to the shore and is 520 feet from the landing pier. The west breakwater has a length of 600 feet. Its outer end is on a line with the direction of the north breakwater prolonged and it is separated from the latter by an opening 150 feet wide. The depth of water in this opening is about 29 feet. The present approved project provides for constructing a breakwater 600 feet long, and about 600 feet west of the outer end of the landing pier, and another north of it 500 feet long, or as much longer as may be found necessary to cover the landing from all dangerous seas.

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This harbor is difficult of entrance for smaller craft in stormy weather, and for larger vessels at any time.

November 29, 1901.—A wharf built by the Chicago and West Michigan Railroad Company formerly extended about 750 feet out into the lake, and its outer extremity was about ¼ of a mile west of the north end of the west breakwater. It is now a total wreck and all that remains are a few pile bents and the timber cribs.

Charts: Grand and Little Traverse Bays; North End of Lake Michigan; Lake Michigan.

PINE LAKE, MICH. *See* Charlevoix.

PORTAGE LAKE, MICH. On the east shore of Lake Michigan, about 8½ miles NNE. ⅝ E. of Manistee, and about 23 miles south of Point Betsie Light. Portage Lake is about 3½ miles long and from ½ to 1½ miles wide. It has a depth of from 4 to 7 fathoms. The village of Onekama is at its inner end. In 1879, when work at this harbor was begun by the Government, there was a channel about 4 feet deep and 180 feet wide connecting Portage Lake with Lake Michigan.

The present approved project contemplates the construction of a harbor of refuge with an entrance from Lake Michigan 370 feet wide and 18 feet deep, protected by piers and revetments. The pier work has been completed, but the channel must still be dredged to a depth of 18 feet to complete the project. The total length of the north pier and revetment, including a wing 114 feet long at the inner end, is 2,200 feet, and the pier projects 1,270 feet beyond the shore line. The total length of the south pier and revetment, including a wing 17 feet long at the inner end, is 2,300 feet, and the pier projects 1,230 feet beyond the shore line; a length of 787 feet of pile work at the east end is in bad condition. The clear width between the piers at the entrance is 362 feet, narrowing to 356 feet inside. The channel from lake to lake is about 2,300 feet long, and bears approximately S. 83° E. The available depth, which has been maintained during recent years by periodical dredging, is about 13 feet, in a narrow channel close to the north pier.

The anchorage is good, but the mooring facilities are poor. There are no bridges. No harbor regulations are enforced.

Charts: Coast Chart No. 9, Lake Michigan; North End of Lake Michigan; South End of Lake Michigan; Lake Michigan.

PORTE DES MORTS, WIS. There is a strong current setting in or out according to the direction of the wind, and many valuable vessels have been lost in consequence thereof. The coast is rock-bound and almost certain destruction to craft going ashore. Several reefs and shoals obstruct the navigation of the channel, such as the detached reefs between Pilot Island and the main shore, and the reefs southeast of Gravel Island, as also the Whales Back, nearly abreast of Porte Des Morts.

Charts: North End of Green Bay; South End of Green Bay; North End of Lake Michigan; Lake Michigan.

PORT WASHINGTON HARBOR, WIS. On the west shore of Lake Michigan about 25 miles north of Milwaukee. An artificial Y-shaped harbor, consisting of a dredged and jettied entrance channel, and two dredged basins. From their respective entrances, the jettied channel bears about N. 64° W., the West Basin about N. 89° W., and the North Basin about N. 18° E. The bluffs forming the lake shore north and south of the harbor have an elevation of 50 feet or more and approach within a few hundred feet of the entrance. The Sauk River, a

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very small stream, does not enter the harbor, but discharges into the lake along the south side of the south pier.

Prior to the improvement the site of the basins had an elevation of but 2 or 3 feet above the lake. The present project provides for the maintenance of the piers and a depth of 13 feet in the entrance channel and basins. The extent of the improvement in progress is the maintenance of existing works. The entrance channel and basins are of a stable character. Occasional dredging is necessary for maintenance.

The north pier is 920 feet long; south pier, 920 feet long (originally 1,326 feet long; 406 feet of the shore end abandoned by the United States and now cared for by private interests); they project beyond the shore line 825 feet and 920 feet, respectively; clear width between them at entrance, 167 feet; at narrowest part, 150 feet. The entrance channel is about 1,200 feet long and is easily and safely navigated. Mid-channel depth, 13 feet, for a width of 120 feet, on June 12, 1901.

The north basin is 740 feet long, 200 feet wide; width at entrance, 190 feet; west basin, 450 feet long, 150 feet wide; width of entrance, 150 feet; depth in both basins, 13 feet. The basins are too small to afford anchorage for vessels. There are good facilities for mooring vessels to the docks, inclosing them on three sides, but during the prevalence of severe gales the seas cause so much disturbance that it is unsafe for vessels to remain inside.

Charts: Coast Chart No. 2, Lake Michigan; South End of Lake Michigan; Lake Michigan.

RACINE HARBOR, WIS. Situated on the west shore of Lake Michigan at the mouth of Root River, about 21 miles S. by E. ¼ E. from Milwaukee. For a considerable distance north and south of the entrance, the lake shore is composed of sand with an elevation of but a few feet above the lake. Originally the point of discharge of the river was variable, depending upon the direction of prevalent winds. Usually there was a depth of from 2 to 3 feet; this would be increased by freshets to 7 feet, and at times there was absolute closure. The improvement of this harbor was begun by private enterprise. Operations were commenced by the United States in 1844 under a plan for dredging and for extending existing piers. Subsequent plans provided for pier extension, for widening and deepening the channel, and for the construction of a breakwater. The breakwater, piers, and 21-foot channel were completed in November, 1900. Since then complaints have been made of difficulty in entering the harbor during northerly gales, on account of the prevalence between the breakwater and the harbor entrance of a strong current to the southward, which carries a vessel seeking entrance so far south that there is danger of colliding with the south pier; with this exception the channel is easily and safely navigated. The extent of the improvement in progress is the maintenance of existing works. Dredging is necessary from time to time to maintain the required depth.

The breakwater extends in a northwest and southeast direction; it is 600 feet long, and its northerly end is situated 586 feet from the north pierhead, and its southerly end 510 feet from the south pierhead. The clear opening or least distance between the north pierhead and the breakwater is 560 feet, and between the south pierhead and the breakwater 506 feet. The breakwater was not designed to and does not afford anchorage ground for vessels, or facilities for vessels to moor to, its object being to protect the harbor from the injurious effects of northeast seas.

The north pier is 1,150 feet long, south pier 1,864 feet long; they project beyond the shore line 1,130 feet and 1,875 feet, respectively, in a direction about

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N. 83° E.; clear width between piers at entrance 252 feet, at shore end of north pier 242 feet, at shore end of south pier and revetment opposite thereto, 235 feet. Least width between docks and revetments below Main Street bridge, 216 feet.

May 17, 1901.—There was a channel 2,850 feet long, 20.3 feet deep, with a least width of 150 feet, referring to stage of water represented on the charts. The actual stage on the date specified was 0.9 foot *lower*.

Connecting with the Government channel, the city authorities have improved the river by dredging from time to time, for a distance of 4,800 feet. During the season of 1901, the navigable depth for a distance of 2,200 feet varied from 14 feet to 18 feet. Above that point there is no data available in regard to the depth but it is known that it has not been dredged for quite a number of years.

Bridges across Root River at Racine Harbor, Wis.

Locality and name of bridge.	Kind.	Height.*	Draw opening in the clear.		Remarks.
			Right.†	Left.†	
		Feet.	*Feet.*	*Feet.*	
Main street	Highway	10.0	58	58.0	One light on top of center of bridge showing red up and down stream when bridge is closed and white when open.
State street (formerly Second street).	do	19.0	55	50.0	Do.
Fourth street	do	18.0	44	36.6	Do.
Chicago, Milwaukee and St. Paul Railway (St. Clair street).	Railway	4.5	50	50.0	Do.
Mead street	Highway	10.0	58	58.0	Do.
Sixth street	do	14.0	57	57.0	Do.
Chicago and Northwestern Railway (between Eighth and Ninth streets.)	Railway		52	51.0	Neither draw is accessible, the rails and timbers being continuous across the ends of the draws. The depth of water would only permit the passage of very small vessels.

*Above stage of water represented on the charts. †Looking downstream toward the lake.

Harbor Rules and Regulations.

SEC. 90. The harbor master is hereby authorized and directed to give orders and directions relating to the location of and change of station of every steamboat, vessel, tug, craft or other float in the harbor within the city of Racine, and every captain, master or other person having in charge any steamboat, vessel, tug or other craft who shall neglect or refuse to comply with any such order or direction given by the harbor master shall be punished by a fine of not less than five dollars nor more than twenty-five dollars and costs of prosecution.

SEC. 91. All steamboats, propellers or tugs coming in or going out of the harbor shall be moved under a low head of steam and slowly, so as not to endanger other crafts or floats, and shall have on board during the nighttime a conspicuous light in full view, and any captain, master or other person in charge of such steamboat, propeller or tug violating any of these provisions shall be fined not less than five dollars nor more than twenty-five dollars and costs of prosecution.

SEC. 92. Any owner, master or other person having in charge any steamboat, propeller, vessel or other craft who shall anchor or otherwise fasten or permit to be fastened any steamboat, propeller, tug, vessel or other craft in the harbor so as to obstruct or hinder the free passage of any other steamboat, vessel or other craft coming in or going out of the harbor shall be fined not less than five dollars nor more than twenty-five dollars.

SEC. 93. All vessels, steamboats, tugs or other craft navigating the harbor of this city, when passing any bridge in this city, shall be moved past such bridge as expeditiously as is consistent with a proper movement in the river, but in no case shall any vessel, steamboat, tug or other craft while passing any bridge

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remain or obstruct the passage across such bridge more than ten minutes, and no vessel, steamboat, propeller or other craft shall be so anchored or fastened as to prevent the speedy and free opening of any bridge, and any captain, master or other person having charge of such vessel, steamboat, propeller or other craft violating any of the provisions of this section shall be fined not less than five dollars nor more than twenty-five dollars and costs of prosecution.

SEC. 94. Whenever any person having charge of any vessel, steamboat, propeller, tug or other craft shall desire to move the same past any bridge reasonable time shall be allowed for opening such bridge, and any person who shall move any vessel, propeller, steamboat, tug or other craft against any bridge or draw thereof before the same shall be opened, to the injury of such bridge, shall be fined not less than five dollars nor more than fifty dollars and costs of prosecution, and shall be held liable to pay damages done such bridge.

SEC. 95. No sail vessel shall pass through the draw of any bridge of this city, except it be towed by a steam craft, and any captain, master or other person having charge of such vessel who shall pass or attempt to pass with such vessel any bridge in violation of the provisions of this section, shall be fined not less than five dollars nor more than twenty-five dollars and costs of prosecution.

SEC. 96. Any person who shall throw into or deposit in Root River within this city any rubbish, earth, or any carcass, or any vegetables or animal matter which may tend to fill up or obstruct said river or to render the waters thereof foul or impure, shall be fined not less than five dollars nor more than twenty-five dollars and costs of prosecution.

SEC. 97. No vessel propelled wholly or partially by steam shall pass up or down the harbor at greater speed than four miles per hour, and any person having charge of such vessel violating the foregoing provision shall be punished by a fine of not less than five dollars nor more than twenty-five dollars and costs of prosecution.

SEC. 98. No vessel shall be towed in the harbor while the anchor of such vessel shall be down or dragging at the bottom of the river, and any person having charge of either such vessel or tug boat violating the provisions of this section shall be fined not less than ten dollars nor more than fifty dollars and costs of prosecution.

SEC. 99. Any person having charge of any vessel, steamboat, propeller, tug or other craft who shall wilfully run such craft into any bridge, pier, protection pier, crib or dock shall be fined not less than twenty dollars nor more than one hundred dollars and costs of prosecution.

SEC. 100. No steamboat, propeller, or tug shall while navigating or being or lying within the harbor of the city of Racine, blow any steam whistle, except when required by the provisions of any law or regulation of the United States, and except when blown as a signal for the opening of any bridge, when three short blasts of not over two seconds' duration for blast may be given, and any person having charge of such vessel or of such steam whistle of any vessel violating the foregoing provisions shall be fined not less than five dollars nor more than twenty-five dollars and costs of prosecution.

SEC. 104. It shall be unlawful to open the bridges hereinafter named, except for repairs, between the hours of 6.30 o'clock a. m. and 7 o'clock a. m.; also between the hours of 12 o'clock noon and 12.20 o'clock p. m.; also between the hours of 12.40 o'clock p. m. and 1 o'clock p. m.; also between the hours of 6 o'clock p. m. and 6.30 o'clock p. m., to wit: Main, Second, Fourth, and Mead street bridges.

SEC. 119. If any person shall land any property at the foot of any street without authority, as provided in the next preceding section, he shall be punished by a fine of not less than five dollars nor more than twenty-five dollars and costs of prosecution, and five dollars for every day said goods shall remain at the foot of such street, with costs of prosecution.

SEC. 120. No person shall unload or cause to be unloaded any cargo or any part thereof of any vessel, propeller, steamboat, barge, or float upon any dock on Root River, within the limits of the city of Racine, in such manner that any portion of such cargo shall project over the line of the docking of said river on the water side thereof, and any person violating the provisions of this section shall be fined not less than five dollars nor more than twenty-five dollars and costs of prosecution.

Charts: Coast Chart No. 8, Lake Michigan; South End of Lake Michigan; Lake Michigan.

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RAPID RIVER, MICH. *See* Whitefish River.

ROUND LAKE, MICH. *See* Charlevoix.

ST. JOSEPH, MICH. On the east shore of Lake Michigan, at the mouth of St. Joseph River, which flows along the city front of St. Joseph between docks and revetments, and empties into Lake Michigan through a channel protected by piers and revetments. The distance from Grand Haven, on the north, is about 67 miles, and from Michigan City, to the southwest, about 35 miles. At the upper end the harbor connects with the Benton Harbor Canal, which extends to the city of Benton Harbor. In its original condition the water area formed by the junction of the St. Joseph and Paw Paw rivers in front of the city of St. Joseph, had a width of about 800 feet, and the narrow and crooked channel leading thence to Lake Michigan varied in depth from 3 to 7 feet.

The latest approved project provides for an entrance and interior channel 18 feet deep, and for a depth of 15 feet in the Benton Harbor Canal and in the turning basin at the mouth of St. Joseph River. The north pier is to be extended 1,000 feet to the 20-foot contour, and the south pier, on a line parallel to the north pier, 1,800 feet to the 18-foot contour. Two hundred feet of the north pier extension and 800 feet of the south pier extension have already been constructed. The total length of the north pier and revetment at the entrance channel is 2,052 feet; at the east end a pile wing 165 feet long connects it with the dock of the U. S. Lighthouse Depot. The pier projects 1,210 feet beyond the shore line and 380 feet beyond the present end of the south pier. The total length of the south pier at the present time is 1,619 feet and it projects 1,340 feet beyond the shore line. The width between piers is 325 feet in the outer section, narrowing to 250 feet inside. The entrance channel bears approximately S. 71° 30′ E. 850 feet, thence S. 56° 30′ E. 1,050 feet, thence S. 78° 15′ E. to the Pere Marquette Railroad bridge. There is a shifting bar in Lake Michigan opposite the entrance, and the channel across it is of varying width and location. The inner harbor is 300 feet wide at its narrowest part, and has a length of 3,500 feet from the inner end of the entrance piers to the mouth of Benton Harbor Canal. The upper end is liable to be shoaled by deposits from St. Joseph River. The Benton Harbor Canal is about 98 feet wide in its narrowest part and 4,700 feet in length.

June 7, 1902.—A survey made between May 2 and 31 showed the following available depths: On the crossing of the bar in front of the entrance, 16.6 feet; gr atest depth on shoalest section between the piers (near the end of the south pier), 18.1 feet, about, in mid-channel. From that point to the mouth of Benton Harbor Canal the channel afforded greater depths, the shoalest point being near the lower approach to the south draw of the Pere Marquette Railroad bridge, with 18.8 feet. In the channel of the Benton Harbor Canal the shoalest section between the mouth and station 9 at Benton Harbor was at the mouth of the Paw Paw River, with 18.1 feet. From station 8 to the basin at the head of the canal the available depth was 17.1 feet. The stage of the lake during the time of the survey varied from −0.5 to −1.9 feet. The depth in the canal is liable to be impaired by the erosion of the imperfectly protected banks.

The winding basin at the upper end of the harbor has a length of 450 feet, a depth of 17 feet, and the width created by widening the dredged channel is 280 feet. The winding basin at the upper end of the Benton Harbor Canal has a greatest width of 250 feet and depth of 17 feet. The width of entrance is 110 feet. The basins afford no room for anchorage and only such facilities for mooring as are provided by the owners of private docks.

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The Morrison Channel, which joins the harbor about 1,200 feet below the upper end, has an irregular channel about 5 feet deep, but it is obstructed by two highway bridges about 700 feet above its mouth.

About 700 feet above the inner end of the entrance piers the harbor is crossed by the Pere Marquette Railroad bridge with a clear width of opening of 100 feet in each draw; three compound red and green lights, showing red up and down stream when bridge is closed and green when open, are situated in a plane 52 feet above water surface and are placed over the longitudinal axis of the bridge, one light being in center of bridge and one on each side at a distance of about 80 feet from center light. The south draw is used by large craft.

Harbor Rules and Regulations—Benton Harbor Canal.

Harbor rules and regulations have been prescribed by the authorities of Benton Harbor as follows:

SECTION 1. The harbor master shall give such orders and directions relative to the location, change of place or station, manner of moving, or use of the Benton Harbor Ship Canal or any other navigable waters of the City of Benton Harbor, vessels, floats, and other water crafts, as may be necessary to promote good order therein, and the safety and equal convenience of such vessels, crafts or floats. He shall also have the power to move or cause to be moved any vessel, craft or float while lying at any dock, wharf, pier or other place while receiving or discharging cargo, or under any other circumstances, where and when in his judgment it is necessary to do so to facilitate the movement of other vessels, floats or crafts, and generally to perform all such duties and make all such orders as are required for the performance of the duties of his office, and of the duties usually performed by harbor masters, and for the enforcement of all ordinances of the city relative to the canals and navigable waters of the city. Any owner, master or other person having charge or control of any vessel or craft, who shall refuse or neglect to obey any such order or directions of the harbor master, shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by a fine of not more than one hundred dollars, or by imprisonment of not more than ninety days in the city prison of Benton Harbor or jail of Berrien County, Michigan, or by both such fine and imprisonment, in the discretion of the court.

SEC. 2. No vessel, craft or float shall be moored or anchored in any slip, canal or navigable water, or at any dock or wharf, so as to prevent the passage of any other vessel, craft or float; no person having the command or in charge of any vessel, craft or float discharging cargo, shall suffer any part of cargo projecting over the front of any wharf or landing after such vessel or other craft shall remove from such wharf or landing place. All vessels propelled by steam should have their smoke pipe so constructed as to prevent sparks or coals of fire escaping therefrom, and such vessels should be moved slowly, and at a speed not exceeding four miles per hour. No master, or owner or other person having charge of any vessel, craft or float shall have the same in any canal, basin or other navigable waters within the city during the season of navigation without having on board or in charge thereof some competent person to control, manage and secure the same. No vessel, craft or float shall be suffered to lie in any canal, basin or navigable waters within the said city adrift or insecurely fastened. All vessels, crafts and floats, whether using steam or otherwise, while in any harbor, canal, basin or waterway, shall have and keep their anchors on board, and their lower yards cock-billed and their upper yards braced up sharp. They shall likewise have and keep on board in the night time, during the season of navigation, a conspicuous light. Any person who violates any provision of this section or neglects or refuses to perform any duty enjoined upon him by this section, shall be punished by fine of not more than one hundred dollars, or by imprisonment of not more than ninety days in the city prison of Benton Harbor, or the jail of Berrien County, Michigan, or of both such fine and imprisonment, in the discretion of the court.

SEC. 3. Whenever there shall be in any canal, basin, or other waterway within this city any vessel, craft or float insecurely fastened, adrift, sunk, or laid up,

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which may be required to be fastened, raised, removed or its location changed, for the equal convenience of other vessels or crafts navigating such waters, the harbor master shall order the master or other persons in charge thereof, to secure, raise, remove or change the location thereof without delay. If any person shall neglect to comply with such order, he shall, on conviction, be punished by a fine of twenty-five dollars, and he shall also be fined ten dollars for each hour he so neglects or refuses to comply with such orders after the expiration of a reasonable time to comply with such order, and in default of such payment and costs, shall, on conviction, be imprisoned in the city jail of Benton Harbor, or in the jail of Berrien County, Michigan, for a term of not more than ninety days, in the discretion of the court.

SEC. 4. If any vessel, craft or float shall not be secured, removed, or its location changed, as provided for in the preceding section, the harbor master may cause such work to be done, and he may employ all necessary assistance, and all the expense thereof may be recovered of the owner, or master or other person in charge of such vessel, craft or float by civil action, or by complaint in a criminal action, and, on conviction thereof, shall be punished as provided in Section Three of this ordinance.

SEC. 5. The harbor master may give such orders relative to the management, location, removal and disposition of rafts of lumber, logs or timber as shall be necessary for the safety and convenience of navigators, and any person or persons in charge of such rafts who shall neglect or refuse to comply with such orders shall be punished by a fine of not more than twenty-five dollars for every offense, or by imprisonment not more than thirty days in the city prison of Benton Harbor, or in the jail of Berrien County, Michigan, or by both such fine and imprisonment, in the discretion of the court.

SEC. 6. No person shall cast, deposit or throw, or suffer to be cast, deposited or thrown, any loose logs or timber, or any earth, ashes, dead animals, offal of slaughtered animals, or any filth or decaying animal or vegetable substance, or any substance dangerous to or a hindrance to navigation, into any canal, waterway, or other navigable water, within the city. Any person who violates any provision of this section shall be punished by a fine of not more than fifty dollars for each such offense, or by imprisonment of not more than thirty days in the city prison of Benton Harbor, or in the jail of Berrien County, Michigan, in the discretion of the court.

Charts: Coast Chart No. 6, Lake Michigan; South End of Lake Michigan; Lake Michigan.

ST. JOSEPH RIVER, MICH. This is a crooked stream obstructed by numerous shoals with depths in channel crossings of from 24 to 30 inches. The part under improvement by the Government extends from the mouth at St. Joseph to Berrien Springs, a distance of about 25 miles. The improvement of this section to make a low-water channel 3 feet deep has been in progress since 1889, and consists in removing snags and logs and closing secondary channels, or concentrating the flow by the construction of dams. Many of the worst places have been improved to the required extent.

From Berrien Springs up to Elkhart, Ind., the river in its original condition was navigable, but it has been obstructed by the construction of several dams for power purposes.

Bridges crossing St. Joseph River below Berrien Springs:

Pere Marquette Railroad bridge. *See* St. Joseph Harbor.

St. Joseph-Benton Harbor Highway bridge, about 400 feet above the upper end of St. Joseph Harbor: West or left draw opening, 66 feet in the clear; east or right draw opening (the one generally used), 62 feet in the clear. Five lights are shown on this bridge, two at one end, two in the center, and one at the other end, all red, and about 12 feet above the water.

Indiana, Illinois and Iowa Railroad bridge, situated about 1,450 feet above the St. Joseph-Benton Harbor Highway bridge: Affords a clear width of

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62 feet in each opening. The channel through the bridge is to be dredged by the railroad company to a depth of 6 feet at low water. No lights.

Napier Highway bridge, about 2 miles above St. Joseph Harbor: A fixed bridge with a clear width of 85 feet in the span across the navigable channel, and a clear height above low water of 25 feet. No lights.

Milwaukee, Benton Harbor and Columbus Railroad bridge, at Yellow Creek, about 5½ miles above St. Joseph Harbor: A fixed bridge with a clear width of 125 feet in the span across the navigable channel and a clear height of 27 feet above the water. No lights.

Charts: Coast Chart No. 6, Lake Michigan; South End of Lake Michigan; Lake Michigan.

SAUGATUCK, MICH. On the east shore of Lake Michigan. Saugatuck, the port of shipment pertaining to this harbor, is on Kalamazoo River about 3 miles above its mouth, which is about 7½ miles south of Holland Harbor, and 19 miles north of South Haven Harbor. At the commencement of Government work in 1869, there existed an improved entrance channel from 5 to 7 feet deep between slab piers 200 feet apart. The lower half of the 3 miles of river below Saugatuck is obstructed by a number of sand bars or shoals through which a temporary channel has been dredged annually for the accommodation of the local traffic during the fruit season. The natural depth across these shoals, and across the bar in front of the entrance, is not more than 5 feet, and the dredged channel fills up very soon after it is made. The available depth in the upper half of the river to Saugatuck is 8 feet. The latest approved project provides for maintaining a channel with a navigable depth of 8 feet. There are two parallel piers at the entrance. The north pier is 715 feet long and projects 250 feet beyond the shore line. The south pier and revetment is 3,863 feet long, and projects 230 feet beyond the shore line. The distance between the piers is about 230 feet; in the bend near the upper end of the south revetment the width of the river is only about 120 feet. Farther up, the river varies in width from 180 to 480 feet The entrance channel between the piers bears about N. 84° E. Owing to the insufficient projection and bad condition of the piers and to the immense accretions of sand from the adjacent sandy wastes, the available depth, across the interior shoals and the outlying bar, that can be counted on at all times, is not more than 5 feet. The 10-foot curve in Lake Michigan is about 900 to 1,000 feet outside the end of the piers, and there has been known to be in this stretch as little as 2.3 feet on the straight course to the entrance, while farther south there is usually, for a distance of a few hundred feet, a depth of 7 to 8 feet in a narrow channel; immediately above this, for a distance of about 2,000 feet, the entire width between the piers is usually occupied by a shoal with about 6 feet depth in the channel of best water, close to the south pier. Thence to the upper end of the revetment around the great bend, 10 feet is available. For a distance of about 800 feet from the end of the revetment, the usual depth is only 5 feet, then comes a reach 700 feet long with 10 feet depth, and above this a 600-foot stretch with 6 to 8 feet. Thence to Saugatuck there is always a depth of not less than 8 feet in a channel somewhat irregular in width and direction. It has been customary to dredge a narrow 8-foot channel through these bars and shoals annually, but the channel does not last long after it is made, and at present it is not probable that the available depth exceeds 5 or 6 feet. At Saugatuck the Kalamazoo River expands into Kalamazoo Lake, across which, in 1897, 12 feet could be carried. From Saugatuck to New Richmond, about 8.7 miles above, the river has

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a width of from 100 to 150 feet and affords, at low water, a narrow and crooked channel for boats drawing not more than 3 feet.

The highway bridge crossing from Saugatuck to Douglas has a clear width in the north draw opening of 38 feet and in the south opening of 40 feet. There is a white light at each end of the draw, 14 feet above the water. At New Richmond the river is crossed by the Pere Marquette Railroad bridge, which was provided in 1900 with a draw span affording a clear width of 40 feet, and by a highway bridge with two draw openings 30 feet wide in the clear, of which the south opening is on the navigable channel. Owing to the peculiar arrangement of the guard piers of the two bridges the width available for vessels is restricted to 25 feet. No lights are shown on the highway bridge. Since the draw span was put into the railroad bridge the river is navigable for a farther distance of 38 miles to Allegan, the channel being narrow and much obstructed by fallen trees and snags, and having a depth of less than 3 feet at low water.

Charts: Coast Chart No. 7, Lake Michigan; South End of Lake Michigan; Lake Michigan.

SHEBOYGAN HARBOR, WIS. On the west shore of Lake Michigan at the mouth of Sheboygan River, and about 51 miles N. by E. of Milwaukee. In its original condition the depth on the bar was from 3 to 4 feet, except during freshets, when it was increased to 6 feet.

Improvements at this harbor, commenced by the harbor commissioners of Sheboygan, under authority of the State of Wisconsin, and continued by the United States, consist of two approximately parallel piers (one at either side of the mouth of the Sheboygan River and extending into Lake Michigan), a dredged channel, and a breakwater. The breakwater is 600 feet long; general direction northwest and southeast; distance from north pierhead 790 feet, from south pierhead 1,020 feet. It was not designed to and does not afford anchorage ground for vessels or facilities for vessels to moor to, its object being to protect the harbor from the injurious effect of northeast seas.

The north pier is 2,370 feet long, and the south pier 2,160 feet long; they project beyond the shore line 1,615 feet and 1,910 feet, respectively; clear width between them at entrance 270 feet, at the narrowest part 234 feet. The extent of the improvement in progress is pier extension and dredging to maintain a channel 19 feet deep.

About 300 feet east of the present pierheads there is a tendency to bar formation, projecting from south to north across the channel entrance. Annual dredging is necessary to maintain the required depth.

From the outer end of the piers the entrance channel extends about S. 89° 45′ W. for about 2,900 feet; thence about S. 38° 27′ W. for about 800 feet; thence about S. 14° 30′ W. for about 700 feet; thence making a sharp turn to the westward and west of north within a distance of about 1,400 feet, it extends for some distance farther in a direction about N. 11° W. *July 12, 1901.*—The channel was about 2,500 feet long, depth 19 feet, at the stage of water represented on the charts, with a least width of 180 feet, and could be navigated with ease and safety. The actual stage on that date was 0.7 feet *lower*.

Connecting with the Government improvement, the city authorities have improved the river for a distance of 7,000 feet by dredging from time to time. At the close of the working season of 1901, the following results had been obtained: For a distance of 2,800 feet, a navigable depth of 20 feet; thence 2,200 feet, a navigable depth of 12 feet; thence 2,000 feet, a navigable depth of 10 feet.

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Bridges across Sheboygan River at Sheboygan, Wis.

Locality and name of bridge.	Kind.	Height.*	Draw opening in the clear.		Remarks.
			Right.†	Left.†	
		Feet.	*Feet.*	*Feet.*	
Eighth street	Highway	12.0	68.0	68.0	Two lights; one on the north side and one on the south side, in longitudinal center of bridge, show red up and down stream when bridge is closed, and white when open.
Pennsylvania avenue	do	9.2	55.0	52.0	One light on the north side and longitudinal center of bridge, shows red up and down stream when bridge is closed, and white when open. Right opening not accessible.
Chicago and Northwestern Railway (Thirteenth street).	Railway	16.3	60.0	60.0	Not lighted; very seldom opened.
Fourteenth street	Highway	11.0	52.5	52.5	Not lighted; very seldom opened.

* Above stage of water represented on the charts. † Looking downstream toward the lake.

Harbor Rules and Regulations.

SEC. 11. All drawbridges within the city of Sheboygan shall be and remain closed from 6.45 o'clock to 7.15 o'clock a. m.; from 12.00 o'clock m. to 12.15 o'clock p. m.; from 12.45 o'clock p. m. to 1 o'clock p. m., and from 5.45 o'clock to 6.15 o'clock p. m. of each day, and any person who shall open such bridges during such time shall pay a penalty of not less than one dollar nor more than five dollars.

* * * * * * *

SEC. 13. Pennsylvania avenue bridge and Eighth street bridge shall be and remain closed for fifteen minutes immediately prior to the schedule time of leaving of all regular trains on the Chicago and Northwestern Railway.

Charts: Coast Chart No. 2, Lake Michigan; South End of Lake Michigan; Lake Michigan.

SOUTH CHICAGO, ILL. *See* Calumet.

SOUTH FOX ISLAND, MICH. *See* Fox Islands.

SOUTH HAVEN, MICH. On the east shore of Lake Michigan, about 22 miles NNE. ¾ E. of St. Joseph, and at the mouth of Black River, which flows into Lake Michigan through a channel protected by piers and revetments. The city of South Haven is situated upon both banks of the river. In 1867, when improvements were begun, there existed a channel 7 feet deep and 85 feet wide between slab piers. The work of improvement executed by the United States extends up the river to the highway bridge. The channel above the entrance piers is fairly stable for the width and depth heretofore maintained, although occasional dredging has been required to remove accumulations of sand and silt brought down by the river during floods, and dislodged from the banks by waves created by passing vessels. Between the piers a sandy shoal forms across the channel at about the shore line, but it is expected that this tendency will be found to have been considerably reduced by the thorough reconstruction of the south revetment during the last two years.

The latest approved project provides for a channel 166 to 173 feet wide and 12 feet deep, between piers and revetments, and for extending the navigable channel ¼ mile up Black River to the highway bridge, by dredging. The entrance channel is protected by parallel piers and revetments 166 to 173 feet apart. The length of the north pier and revetment is 1,793 feet, and of the south pier

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and revetment 1,782 feet. The north pier projects 910 feet, the south pier 710 feet, beyond the shore line. The channel between the piers has a length of 1,790 feet and bears approximately N. 80° 45′ E.; the channel in the river above, to the highway bridge, has a length of 2,600 feet. A shifting bar usually exists immediately in front of the entrance, through which a pass not less than 50 feet wide and 16 feet deep has been maintained by dredging, but this width and depth are sometimes considerably reduced during the fall and winter storms and must then be restored as soon as possible after the opening of navigation. Between the piers the channel has never been dredged out for its full width, but a depth of 14 feet, for a width of 50 feet near the south pier, has been maintained by dredging. The north half of the channel from the shore line to the inner end of the revetment is too shoal for the purposes of navigation. The river from the Government revetments to the bridge varies in width from 90 to 200 feet. About 500 feet below the bridge a basin, for winding purposes, has been excavated in the north bank of the river, which widens the channel at that place to 260 feet. Anchorage and mooring facilities do not exist.

June 7, 1902.—Dredging commenced May 19 and completed May 30 resulted in producing an available depth of 16 feet across the bar, 14 feet between the piers, and 13.4 feet in the river as far as the steamboat landing of the Dunkley-Williams Line. The channel across the bar was dredged for a width of 120 feet, and a shoal point opposite the end of the south pier was removed to the same depth. The channel between the piers was widened and deepened by a cut 570 feet long and 30 feet wide, and cuts of the same width were made in the river, just below and just above the winding basin. The stage of the lake during the dredging varied from −1.0 to −1.6 feet.

The highway bridge at Dyckman street has a clear width of 58 feet in the east, or left draw, opening, and 61 feet in the west, or right draw, opening. The left opening is available for small craft only. No lights are shown on this bridge.

Black River is navigable for small craft for some distance above the bridge. Farther up it has three branches, all adapted to rafting timber.

HARBOR REGULATIONS passed by the Village of South Haven, March 5, 1902, are in force as follows:

SECTION 1. That no boat, water craft or float shall anchor or moor in Black River within said village in such manner as to interfere with or obstruct the safe and free use of said river for navigation; except as it may be necessary for the same to receive or discharge a cargo, and at no time shall any such vessel, water craft or float entirely obstruct navigation in said river, except as it shall be necessary for the purpose of turning or passing in or out of said river.

SEC. 2. When any boat, water craft or float shall be anchored or moored in such manner as to interfere with or obstruct the safe or free use of said Black River, within said village, for navigation, it shall be the duty of the harbor master to at once notify in writing the owner or person exercising control of such boat, water craft or float, of such fact, and also notify such owner or person exercising control of such boat, water craft or float to remove the same at once. In case the owner of such boat, water craft or float shall not be known, or if known and his whereabouts are unknown, and there shall be no one exercising control thereof, then such notice shall be served upon the person, if known and can be found, who last exercised authority or control over such boat, water craft or float.

SEC. 3. In case such owner, or person exercising or having control over any such boat, water craft or float, shall neglect or refuse to remove the same after such notice, or in case the owner or the person exercising or having exercised control over such boat, water craft or float, if not known, or if known and his whereabouts are such that the length of time required to serve such notice would cause damage to parties lawfully using said river for purposes of navigation then said harbor master shall remove said boat, water craft or float in such

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manner as to cause the least damage and expense thereto, and shall remove the obstruction or interference to navigation. For that purpose said harbor master may remove such boat, water craft or float, to any other dock in said river, or if necessary to preserve said boat, water craft or float and to remove the obstruction and interference to navigation he may remove the same to the nearest port on Lake Michigan where dockage may be had.

SEC. 4. All worthless and abandoned boats, water craft or floats which obstruct or interfere with navigation of said river may be destroyed by said harbor master with dynamite or otherwise; but before destroying any such boat, water craft or float said harbor master shall give the same notice as is provided in section 2 of this ordinance upon the owner if he is known and can be found.

SEC. 5. All charges and expense of moving said boat, water craft or float, mentioned in the foregoing sections hereof, all charges for dockage and all other charges incurred under the provisions of this ordinance shall be a first lien on said boat, water craft or float in favor of said village, to be enforced as hereinafter provided. The owner of such boat, water craft or float shall also be personally liable for such charges and expense above mentioned to be recovered by said village as in personal actions.

SEC. 6. When said village shall have incurred any expense by moving any such boat, water craft or float, said harbor master shall cause the same to be safely and properly moored and left in charge of responsible persons. Said harbor master, after ten days, if the owner or person entitled to possession thereof shall not have appeared and claimed said boat, water craft or float, and paid the amount of said lien thereon, shall proceed to sell the same at public auction, after giving ten days notice thereof in two of the newspapers published in said village, setting forth the time and place of such sale and of the time the sale shall be left open. Provided that when the owner or owners of any such boat, water craft or float are known and their residences are known said harbor master shall cause a copy of said notice of sale to be mailed to such owner or owners at least five days before the date of such sale.

SEC. 7. The harbor master shall receive the sum of five dollars per day for the services rendered under this ordinance for such time as shall actually be spent in performing said services.

SEC. 8. The harbor master is hereby authorized and directed to give orders and directions relating to the location of and change of station of every steamboat, vessel, tug, craft or other float within the harbor in the city of South Haven, and every captain, master or other person having in charge any steamboat, vessel, tug or other craft who shall neglect or refuse to comply with any such order or direction given by the harbor master shall be punished by a fine of not less than five dollars nor more than twenty-five dollars and the costs of prosecution.

SEC. 9. All steamboats, propellers or tugs coming in or going out of the harbor shall be moved under a low head of steam and slowly, so as not to endanger other crafts or floats, and shall have on board during the night time a conspicuous light in full view, and any captain, master or other person in charge of such steamboat, propeller or tug violating any of these provisions shall be fined not less than five dollars nor more than twenty-five dollars and costs of prosecution.

SEC. 10. Any owner, master or other person having in charge any steamboat, propeller, vessel or other craft who shall anchor or otherwise fasten or permit to be fastened any steamboat, propeller, tug, vessel or other craft in the harbor so as to obstruct or hinder the free passage of any other steamboat, vessel or other craft coming in or going out of the harbor shall be fined not less than five dollars nor more than twenty-five dollars.

SEC. 11. Any person who shall throw into or deposit in Black River within this city any rubbish, earth or any carcass, or any vegetables or animal matter, which may tend to fill up or obstruct said river or to render the waters thereof foul or impure, shall be fined not less than five dollars nor more than twenty-five dollars and costs of prosecution.

SEC. 12. No vessel propelled wholly or partially by steam shall pass up or down the harbor at greater speed than four miles per hour below Dyckman Avenue bridge, and any person having charge of such vessel violating the foregoing provisions shall be punished by a fine of not less than five dollars nor more than twenty-five dollars and costs of prosecution.

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SEC. 13. No vessel shall be towed in the harbor while the anchor of such vessel be down or dragging at the bottom of the river, and any person having charge of either such vessel or tug boat violating the provisions of this section shall be fined not less than ten dollars nor more than fifty dollars and the costs of prosecution.

SEC. 14. Any person having charge of any vessel, steamboat, propeller, tug or other craft who shall wilfully run such craft into any bridge, pier, protection pier, crib or dock shall be fined not less than twenty-five dollars nor more than one hundred dollars and costs of prosecution.

SEC. 15. No person shall unload or cause to be unloaded any cargo or any part thereof of any vessel, propeller, steamboat, barge or float upon any dock on Black River within the limits of the City of South Haven, in such manner that any portion of such cargo shall project over the line of the docking of said river on the water side thereof, and any person violating the provisions of this section shall be fined not less than five dollars nor more than twenty-five dollars and costs of prosecution.

SEC. 16. Any river captain or master of any boat, water craft or float who shall violate sections 1, 2, 3, 4, 5, 6, or 7 of this ordinance shall upon conviction thereof be liable to a fine of not less than five nor more than one hundred dollars for each offense or may be imprisoned in the village jail not more than sixty days or both such fine and imprisonment in the discretion of the court.

Charts: Coast Chart No. 6, Lake Michigan; South End of Lake Michigan; Lake Michigan.

SOUTH MANITOU ISLAND, MICH.—The harbor of South Manitou is protected from all winds from northeast through west to southeast, with good holding ground. A United States life-saving station has been established at the south side of the harbor.

Charts: Manitou Passage; Grand and Little Traverse Bays; North End of Lake Michigan; Lake Michigan.

SOUTH MILWAUKEE HARBOR, WIS. At the mouth of Oak Creek, about 9 miles to the southward of Milwaukee Harbor. The clay bluffs forming the lake shore to the north and south have an elevation of 60 feet or more above the lake. The original depth of water at Oak Creek varied from about 3 feet to zero.

The present project provides for building piers 250 feet apart extending to the 20-foot contour, and dredging between them a channel 200 feet wide and 18 feet deep.

The north pier, 785 feet long, and the south pier, 300 feet long, project beyond the shore line 500 feet and 140 feet, respectively, and the distance between them is 200 feet. The north pier was extended 185 feet by the United States in 1897; the remainder of the piers was built by private interests. The channel between the piers runs about S. 70° E.

April 28, 1897.—The depth of water at the outer end of the north pier was about 11 feet, and at the outer end of the south pier about 6 feet, referring to stage of water represented on the charts. The actual stage on the date specified was 2 feet *lower*.

In 1892 a small amount of dredging was done between the piers by private interests, but it proved to be of no permanent value.

The improvement of this harbor is not yet far enough advanced to be of value to the interests of navigation.

Charts: Coast Chart No. 3, Lake Michigan; South End of Lake Michigan; Lake Michigan.

SPRING LAKE, MICH. *See* Grand Haven.

STONY LAKE, MICH. *See* Benona.

STURGEON BAY CANAL, HARBOR OF REFUGE AT ENTRANCE TO.—The distance across the peninsula to the head of Sturgeon Bay was about 1⅛ miles, with a maximum elevation of 28 feet above the lake.

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The present project provides for the maintenance of existing works. The north pier consists of a main pier 1,194 feet long, and a detached pier 150 feet long; total length 1,344 feet; they are connected by 165 feet of guide or fender piling. The south pier is of the same length and construction. They project beyond the shore line 1,320 feet and 1,054 feet, respectively; the clear width between them at the entrance is 335 feet, at the narrowest part, 235 feet, and at the shore line, 789 feet. The channel extending from the pierheads to the canal entrance is 1,230 feet long, 17 feet deep, 255 feet wide at the lake entrance, and 115 feet wide at the entrance to the canal, and easily and safely navigated. There is a tendency to bar formation, caused by material carried by currents in the canal. Annual dredging is necessary to maintain the required dimensions.

The basin formed by the converging piers is 1,060 feet long, measuring from its narrowest portion to the canal entrance; it is from 789 to 235 feet wide and has an average depth of about 10 feet outside the 17-foot channel described above. It is not adapted for anchorage or moorage of vessels; the clear width of the lake entrance is 235 feet, and of the canal entrance, 130 feet. For the harbor rules and regulations prescribed by the Secretary of War, see Sturgeon Bay and Lake Michigan Ship Canal.

This work is a harbor of refuge in name only, but is essential as an exterior work affording a safe entrance to the canal.

The extent of improvement in progress is the maintenance of existing works.

October 16, 1901.—The maximum draft that could be carried at mean lake level was 17 feet. The actual stage on the date specified was 1 foot *lower.*

Charts: Sturgeon Bay, Canal, and Harbor of Refuge; Coast Chart No. 1, Lake Michigan; South End of Green Bay; North End of Lake Michigan; Lake Michigan.

STURGEON BAY AND LAKE MICHIGAN SHIP CANAL, WIS. This water way connects the waters of Lake Michigan with those of Green Bay through an arm of the latter known as Sturgeon Bay, the head of which in its natural condition was separated from Lake Michigan by a narrow neck of land about 1⅛ miles wide, with a maximum elevation above lake level of about 28 feet.

The original canal, as built by the Sturgeon Bay and Lake Michigan Ship Canal and Harbor Company, was 7,200 feet long, 100 feet wide between revetments, and 14 feet deep, and, in continuation, a channel 6,100 feet long, of about the same width and depth as the canal, was dredged in Sturgeon Bay, and about 60 per cent of the canal banks revetted.

The United States assumed control in April, 1893.

The existing project provides for completing the revetments, widening the canal to 160 feet, except the westerly 1,000 feet, which is to be 250 feet between revetments, with a channel 200 feet wide and 15 feet deep. The revetments on each side of the canal are completed for a distance of 6,850 feet; the clear width between them at the lake entrance and for a distance of 240 feet, is 130 feet; thence 5,960 feet, 160 feet; thence 650 feet, 250 feet. The character of the channel is stable, although occasional dredging is necessary to maintain the required dimensions.

November, 7, 1901.—The channel of the canal proper was 7,200 feet long and 15 feet deep; the minimum width at the lake entrance was 110 feet for a distance of 250 feet, and for the remaining 6,950 feet, the least width was 130 feet. The channel in Sturgeon Bay, 6,100 feet long, had a least width of 100 feet and a depth of 15 feet at the stage water represented on the charts. On the date specified the stage was 1.3 feet *lower.*

The channels are well provided with lights, and are easily and safely navigated.

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Bridge.

Locality and name.	Kind.	Height.*	Draw opening in the clear.		Remarks.
			Right.†	Left.†	
Connects St. John street, city of Sturgeon Bay, with the village of Sawyer, Door County, Wis.	Combined highway and railway.	*Feet.* 12	*Feet.* 77	*Feet.* 77	One light on top of center of draw span shows red to navigators when bridge is closed and white when bridge is open.

* Lowest part of superstructure above water surface at the stage of water represented on the charts.
† Looking toward Lake Michigan.

Regulations Prescribed by the Secretary of War for the Navigation and Use of Sturgeon Bay and Lake Michigan Ship Canal; as Modified September 27, 1899.

1. *Authority of canal officers.*—The movement of all boats and floating things in the canal, and in the approaches thereto, shall be under the direction of the Superintendent, or his authorized assistants and their orders and instructions must be obeyed.

2. *Signals.*—On entering the canal at either entrance steamers or tugs must blow their whistles for one minute in order to warn craft approaching from opposite direction and give them time to guard against collisions, by tying up if necessary. All steamers approaching others going in the opposite direction shall slacken speed so as to pass in safety. Compliance is required with Rule V of the rules and regulations for the government of pilots adopted by the Board of Supervising Inspectors.

"Rule V: Whenever a steamer is nearing a short bend or curve in the channel where, from the heights of the banks or other cause, a steamer approaching from the opposite direction can not be seen for a distance of half a mile, the pilot of such steamer, when he shall have arrived within half a mile of such curve or bend, shall give a signal by one long blast of the steam whistle, which signal shall be answered by a similar blast, given by the pilot of any approaching steamer, that may be within hearing. Should such signal be so answered by a steamer upon the farther side of such bend, then the usual signals for the meeting and passing shall immediately be given and answered, but if the first alarm signal of such pilot be not answered he is to consider the channel clear and govern himself accordingly."

3. *Speed.*—The rate of speed while passing through the canal shall not exceed 3 miles per hour.

4. *Keeping in the center.*—The center must be kept all the way through except in passing other craft. In case of grounding, the rapid or strong working of boat's engines is strictly forbidden.

5. *Rafts.*—The passage of "bag" or "sack" rafts, or of loose logs, into or through the canal, is prohibited.

Rafts shall be made up with logs parallel to each other, in the direction of raft lengths, secured and held closely together by frequent cross sticks, chains, or cables.

Rafts shall not be of greater dimensions, either way, than 50 feet wide by 600 feet long, and if longer than 300 feet shall be handled by two tugs.

No raft shall pass through the canal, unless by special permission of the Superintendent or his authorized assistants, who will direct a time for passing that will least interfere with other navigation.

Masters of tugs and other persons in charge of rafts are required to avoid damaging canal revetments and displacing buoys, spars, or the pedestal of any range light aiding navigation through the canal. They shall keep careful watch when passing aids to navigation and should any be accidentally displaced, shall report the fact at the earliest possible moment to the Superintendent or his authorized assistants.

6. The canal is for transit only; therefore vessels and boats are forbidden: (*a*) To land at or tie up to the banks or come to anchor in the canal unless on Government business or to avoid immediate danger or loss; (*b*) to enter the canal

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two or more abreast; (*c*) to pass another while going in the same direction in the canal; (*d*) to pass the canal in more than one line going each way; (*e*) to obstruct the canal in any way, or to delay, by slow passage through the canal, or by any other means, the progress of other vessels; (*f*) to attempt passing the canal in the face of running ice, except at their own risk and liability to make good any damage to the canal or its banks which may result from such attempt.

7. *To shorten sail.*—No vessel, however propelled or being towed, shall pass through the canal with sail or sails up except sail vessels running with a fair wind. Every craft that sails into or attempts to sail into or through the canal must be responsible for any damage resulting therefrom.

8. *Harbor of refuge.*—All steamers, vessels, scows, and rafts are strictly forbidden to anchor or otherwise be secured, so as to injure the banks, docks, or wharves; obstruct or in any manner impede the progress and safety of such as desire to pass through; and in no case will they be allowed to remain in the canal, as above mentioned, longer than is absolutely necessary to secure them from immediate loss or damage. Under no circumstances will any tug, vessel, scow, raft, or any other craft of whatsoever kind be permitted to tie up or lay along the south bank of the canal, and craft coming into the canal from Lake Michigan for shelter will be required to pass on through the same to Sturgeon Bay where ample harbor room can be found. Craft bound out, detained by bad weather, will also be required to remain in Sturgeon Bay instead of coming as far as the canal to await favorable weather.

9. *Towing.*—All boats engaged in towing vessels that are laden, or partially laden, shall use two towlines and shorten them to the greatest extent, so as to have full control of their tows, and thereby avoid accident while meeting or otherwise passing other craft. Boats that are towing vessels without cargo need use but one towline, but the line between the steamer and the first vessel or barge of the tow, must not exceed 100 feet in length. Towing more than one craft abreast, or rafts of greater width than 50 feet, is forbidden.

Towing in the same tow, of more than one scow or barge of 1,000 tons or more, of a draft not exceeding 10 feet when loaded, whose load is carried on the deck, is hereby prohibited, except upon condition that there shall be two towlines between each vessel in the tow, the lines to be secured to the starboard and port quarters of each craft, and to be of a length not to exceed 25 feet in the clear.

10. *Making fast.*—Making fast to the trestle of the elevated walk leading to the pierhead lighthouse, or the sheet piling, or docking at the sides of the canal, is forbidden.

11. *Injury to cribs, piers, and sheet piling.*—Vessels shall use great care not to strike or injure the cribs, piers, sheet piling or any structure pertaining to the canal.

12. *Refuse in canal.*—No person shall roll or throw any stones, ashes, cinders, or other material into the canal or the approaches thereto, or place any such material on any bank or berm of the canal, so that it is liable to be thrown or rolled in.

13. *Draft of boats.*—No vessel shall enter the canal whose actual draft exceeds the least depth of water in the channel of the canal as given by the Superintendent.

14. *Turning around in canal.*—Tugs or other steam vessels exceeding 100 feet in length, are forbidden to turn around, or to attempt to turn around, in those portions of the canal that have not yet been widened.

15. *Obstructing navigation.*—Any one who shall willfully or through carelessness in any way obstruct the free navigation of the canal, or by the violation of any of the laws or regulations governing the canal and those using it, delay or inconvenience any boat having the right to use the canal, shall be responsible for all damages and delays, and for all expenses of removing the obstructions.

16. *Commercial statistics.*—The masters or clerks of all vessels using the canal (except in the case of vessels merely entering to seek a harbor of refuge from storms and not bound through) shall furnish in writing to the Superintendent a detailed statement of passengers and cargo carried.

17. Tugs engaged in the towing business are excepted from the operation of Rule 6, paragraph (*a*), and Rule 8, in so far that while waiting for tows they may lie in the harbor of refuge, or at such points along the north canal bank as

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may be designated by the Superintendent. They must, however, move out of the canal whenever the Superintendent shall deem it necessary for the accommodation of other craft.

18. *Vessel or craft sinking in canal.*—In case of any boat, vessel, or other craft, or raft, sinking or grounding in the canal, or otherwise obstructing it, the officer, or agent of the United States in charge of the canal, shall have the right to take such possession of such vessel, boat, or other craft, or raft, as shall be necessary for the purpose, and remove it, and clear the canal of the obstruction caused by it, and no one shall interfere with or prohibit him from doing so, or do anything that will tend to interfere with or prohibit him from doing so: *Provided*, That the officer, or agent of the United States may, in his discretion, give notice in writing to the owners of any vessel, boat, or other craft, or raft, obstructing the canal as aforesaid.

Charts: Sturgeon Bay Canal and Harbor of Refuge; Coast Chart No. 1, Lake Michigan; South End of Green Bay; North End of Lake Michigan; Lake Michigan.

SUTTON BAY, MICH. *See* Grand Traverse Bay.

TACOOSH RIVER, MICH. *See* Whitefish River.

TWO RIVERS HARBOR, WIS. On the west shore of Lake Michigan, about 78 miles N. by E. of Milwaukee. East and West Twin rivers unite immediately inside the original shore line of Lake Michigan, and discharge through a common outlet into the lake, between two piers extending about S. 33° E. The lake shore, for a distance of several miles each side of the harbor, is composed of sand, but slightly elevated above the lake. The original governing depth on the shifting bar at the entrance was from 2 to 3 feet. The work of improvement was commenced by the United States in 1872 under a plan which provided for the construction of two parallel piers extending into Lake Michigan at the outlet of the rivers.

The existing project provides for the maintenance of the harbor piers and channel between them of navigable width, 13 feet deep. The north pier, 1,810 feet long, and south pier, 1,710 feet long, project beyond the shore line 1,105 feet and 910 feet, respectively; clear width between them at entrance 250 feet, at narrowest part 240 feet. There is a tendency to the formation of sand bars, at and near the harbor entrance, which decreases the depth of water about 1 foot. Dredging is annually necessary to maintain the required depth. In all other respects there are no dangers or difficulties attending navigation.

August 6, 1901.—The channel was 1,810 feet long, 13 feet deep, with least width of 160 feet. The depth given refers to the stage of water represented on the charts. The actual depth on the date specified was 0.5 foot *lower*.

East Twin River was formerly navigated by boats of 7 feet draft for a distance of 3 miles from Lake Michigan. For many years past it has been used by rowboats only. West Twin River has a minimum depth of 7 feet from Two Rivers Harbor to Kingsville, a distance of about 7 miles. It has not been navigated by vessels for a number of years, but used for floating saw logs.

Harbor Rules and Regulations.

SECTION 1. The signal for opening the bridges on West Twin River in said city for the passage of vessels and all steam or other craft sailing or plying in the harbor and rivers of said city shall be three long blasts.

SEC. 2. The signal for opening the bridge on East Twin River in said city for the passage of vessels and all steam or other craft sailing or plying in the harbor and rivers of said city, shall be two long blasts.

SEC. 3. The bridge tender or other person whose duty it is or may be to tend and open the said bridges for the passage of such vessels and crafts shall promptly respond to such bridge signals and open the bridge indicated by the signal.

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SEC. 4. All officers or persons in charge of such vessels, steam or other craft, desiring to pass through or by either bridge shall give the signals established and required to be given by this ordinance at least 600 feet distant from said bridges.

SEC. 5. No bridge shall be opened between the hours of 6 and 7 a. m., and between 12 and 1 p. m., and from 5.30 to 6.30 p. m.

Bridges.

Locality and name of bridge.	Kind.	Height.*	Draw opening in the clear.			Remarks.
			Right.†	Left.†	Center.	
EAST TWIN RIVER.		*Feet.*	*Feet.*	*Feet.*	*Feet.*	
Walnut street	Highway	12.5			40	Not lighted for navigation purposes; seldom opened.
WEST TWIN RIVER.						
Washington street	do	9.5			52	Do.
Monroe street	do	7.7			47	Do.

*Above stage of water represented on the charts. †Looking downstream toward the lake.

Charts: Coast Chart No. 1, Lake Michigan; South End of Lake Michigan; Lake Michigan.

WAUKEGAN HARBOR, ILL. An artificial L-shaped harbor on the west shore of Lake Michigan about 34 miles from the entrance to Chicago River, and about 46 miles from the entrance to the harbor at Milwaukee. From the outer end of the piers the entrance channel extends about N. 89° W. 750 feet, thence about N. 69° W. 480 feet, thence the basin extends about due north. North and south of the harbor the lake shore, for a distance of several miles, is composed of sand and has an elevation of but a few feet above the lake. At about 1,500 feet westward, the plateau upon which the city of Waukegan is chiefly built has an elevation of from 30 to 50 feet. Original depth of water at shore line, zero. The work of improvement of this harbor was commenced by the United States in 1855 under a plan for the construction of a breakwater, but the first cribs placed were destroyed, and nothing further was done until 1881, when operations were resumed under a plan for the construction of an artificial harbor by inclosing a portion of Lake Michigan by pile piers, and dredging the inclosed area.

The present project provides for the maintenance of existing works, which consist of the piers for protecting the harbor entrance and the basin, and a channel 13 feet deep between the piers and in the basin. The north pier, 1,867 feet long, and the south pier, 1,628 feet long, project beyond the shore line 820 feet and 1,420 feet, respectively; clear width between them at entrance 240 feet, at narrowest part 235 feet. The littoral drift of sand from north to south is very large in this vicinity, and has caused a material advance of the shore line north of the harbor entrance, also a tendency toward bar formation between the piers and outside of the pierheads. Dredging is occasionally necessary to maintain the required depth.

July 17, 1901.—There was a channel between piers about 1,120 feet long, 13 feet deep, with least width of 160 feet; for a width of about 80 feet this channel had a depth of about 18.5 feet, having been dredged by the city of Waukegan and the Western Coal and Dock Company without expense to the United States. The basin is about 900 feet long, measuring from the south pier, 300 feet wide,

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and 19 feet deep; entrance about 300 feet wide. It is not adapted to the anchorage of vessels, the area being too limited for that purpose. Vessels can moor to the docks, but during the prevalence of severe gales the seas cause so much disturbance that it is not safe to remain. The Western Coal and Dock Company has extended the basin northerly about 300 feet to connect with their slip, which has a general direction of northwest and southeast, and is about 650 feet long, 125 feet wide, and 19 feet deep.

The dangers and difficulties attending navigation consist of two large bowlders in the Government basin; one is located about 230 feet from the south pier, and the same distance from the shore; the other about 200 feet south of the Western Coal and Dock Company's coal shed, and 90 feet east of the city dock. The depth of water over them is 13.9 feet and 16 feet, respectively. All of the foregoing depths given refer to the stage of water represented on the charts. The actual stage on the date specified was 0.6 foot *lower*.

The extent of improvement in progress is the maintenance of existing works.

RULES AND REGULATIONS for Waukegan Harbor, approved by the Secretary of War, October 8, 1894:

All vessels or craft are forbidden to tie to or lie alongside of the United States harbor piers at Waukegan, Ill., except they are engaged on Government business, or are compelled by stress of weather or accident, or to prevent loss of life or property. They are likewise forbidden to lie at anchor in the basin or channel of said harbor, except for refuge from storms, or in any way to obstruct free navigation of said harbor.

Charts: Coast Chart No. 4, Lake Michigan; South End of Lake Michigan Lake Michigan.

WEST TWIN RIVER, WIS. *See* Two Rivers.

WHITEFISH RIVER, MICH. *Oct. 22, 1894.*—The Whitefish, Rapid, and Tacoosh rivers, the former only used for logging, and the latter two only small creeks, empty into Little Bay de Noquette through a common channel, which lies between two long points of shoals extending a long distance out from the west shore of the bay at Masonville, and from the east shore opposite. This channel is narrow and tortuous and is said to have but about 4 feet of water at shoalest places. It is believed upon the best information obtainable that the bottom of the channel, under a covering of gravel and clay, is flat rock at a depth of 8 feet or so at ordinary stages.

Charts: North End of Green Bay; North End of Lake Michigan; Lake Michigan.

WHITE LAKE, MICH. On the east shore of Lake Michigan, about 11 miles NNW. of the entrance to Muskegon Harbor. This improvement gives access from Lake Michigan to White Lake, which is the harbor for the towns of Montague and Whitehall, at its head. The present artificial entrance channel has been made by the Government. The original outlet of White Lake was about 8,550 feet farther north, and afforded a channel 5 feet deep and about 85 feet wide between slab piers built by local enterprise. The work of improvement was commenced by the United States in 1867 under a plan which provided for the abandonment of the old outlet and the construction of a new one 12 feet deep and 200 feet wide, with revetments, and with protecting piers extending into Lake Michigan. Subsequent plans provided for dredging and pier extension. The length of the north pier and revetment is 1,715 feet, and of the south pier and revetment 1,953 feet. The north pier projects 530 feet, and the south pier 790 feet, beyond the shore line, and 170 feet beyond the end of the north

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pier. These piers are practically parallel, and the width between them is 184 to 188 feet. The channel between the piers is about 1,950 feet long, and bears about N. 86° 30′ E. At the outer end the available depth on line with the south pier is 15.6 feet, while the northern half of the entrance is much shoaler. Farther inside the depth at the time of the last soundings was 13.3 feet in the middle of the channel. Immediately after leaving the entrance channel, the line of best water in White Lake bends to the south around a shoal projecting from the north shore. White Lake is about 4¼ miles long, from ¼ to 1¼ miles wide, and has a depth of 25 to 60 feet. This is the only basin. Anchorage is good, but mooring facilities do not exist. No bridges exist and no harbor regulations are enforced.

Charts: Coast Chart No. 8, Lake Michigan; South End of Lake Michigan; Lake Michigan.

WOLF RIVER, WIS. *See* Ahnapee.

NOTE.—This bulletin is made up chiefly from data supplied by Lieut. Col. O. H. Ernst, Corps of Engineers, Chicago, Ill., Maj. J. G. Warren, Corps of Engineers, Milwaukee, Wis., and Capt. Charles Keller, Corps of Engineers, Grand Rapids, Mich., from former bulletins, and from annual and special reports of the officers of the Corps of Engineers. The matter has been edited principally by Mr. Herbert L. Buell, Office of the Chief of Engineers.

Additional information received subsequent to May 22, 1902, was inserted while the bulletin was going through the press.

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